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# IDENTIFICATION AND ANALYSIS OF SELECTED HIGH PRIORITY WATER PROBLEMS AND RELATED RESEARCH NEEDS OF THE MISSOURI RIVER BASIN

1978

## COMPLETION REPORT



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Iowa State Water Resources  
Research Institute  
Rm 403 Town Engineering Bldg.  
Iowa State University  
Ames, Iowa 50010  
515-294-8921

Millard W. Hall, Director  
Water Resources Research Institute  
310 Ag Hall - East Campus  
University of Nebraska  
Lincoln, Nebraska 68503  
402-472-3307

Helmer Holje, Director  
Montana University Joint Water  
Resources Research Center  
Montana State University  
Bozeman, Montana 59715  
406-994-2891

Robert Koob, Acting Director  
Water Resources Research Institute  
North Dakota State University of  
Agriculture and Applied Science  
 Fargo, North Dakota 58102  
701-422-2334

Paul A. Rechard, Director  
Water Resources Research Institute  
The University of Wyoming  
P. O. Box 3038 - University Station  
Laramie, Wyoming 82070  
307-766-2143

\*\*\*\*\*

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Brookings, South Dakota 57006  
605-688-4910

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Waters Annex  
Kansas State University  
Manhattan, Kansas 66506

Council Representative

George E. Smith, Director  
Missouri Water Resources  
Research Center  
University of Missouri  
424 Clark Hall  
Columbia, Missouri 65201  
314-882-3421

IDENTIFICATION AND ANALYSIS OF SELECTED HIGH  
PRIORITY WATER PROBLEMS AND RELATED RESEARCH NEEDS  
OF THE MISSOURI RIVER BASIN

by  
Missouri River Basin  
Water Institute Consortium

Project Number X-135-Neb.  
Agreement Number - OWRT-USDI 14-31-0001-9079

March 1973 - March 1976

COMPLETION REPORT

March 1976

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PROJECT TITLE: IDENTIFICATION AND ANALYSIS OF SELECTED HIGH PRIORITY WATER PROBLEMS AND RELATED RESEARCH NEEDS OF THE MISSOURI RIVER BASIN

PROJECT COORDINATOR: Dr. Warren Viessman, Jr. - Nebraska

CO-INVESTIGATORS: George E. Smith - Missouri  
William Powers - Kansas  
Paul A. Rechard - Wyoming  
Helmer Holje - Montana  
John L. Wiersma - South Dakota  
Robert Koob - North Dakota  
Merwin D. Dougal - Iowa  
Norman A. Evans - Colorado  
William C. Walton - Minnesota

DATES: March 1973 with original closing date of March 1975 extended to March 1976

PROJECT OBJECTIVES:

- (1) Identify the principal water resources problems of the Missouri River Basin.
- (2) Determine the most reasonable alternatives for solving these problems.
- (3) Identify research needed to permit cost-effective solutions.
- (4) Evaluate mechanisms to implement the needed research.
- (5) Assign priorities, estimate approximate costs and evaluate funding opportunities.

RELEVANCE OF RESEARCH:

The Missouri Basin is the largest single region designated by the Water Resources Council. It includes all or part of ten states and has a varied climate, geology and topography. There are problems of water excess and deficiency. Urban and rural extremes exist, and almost every conceivable water-related issue can be identified.

Federal agencies in the Missouri River Basin are charged with developing a comprehensive regional plan for effective development and management of the area's resources. Individual state agencies are also heavily involved in planning activities. To complement these programs, additional data and research are needed. This project is assessing these needs and evaluating procedures for implementing the required research.





## RESEARCH PROCEDURES:

### MRBWIC

The Missouri River Basin Water Institute Consortium (MRBWIC) was formulated in 1972 by the Institute Directors within the Missouri Basin for the purpose of coordinating research planning and implementation pertaining to regional water problems. It is an informal organization having an elected chairman and secretary. The Directors of eight states, Nebraska, Missouri, Kansas, Wyoming, North Dakota, South Dakota, and Iowa have actively participated as co-investigators with the Colorado Director playing a vital but less active role. The Director of Minnesota served as an observer. Each state possessed unique strengths in various disciplines so that collectively there is available a well trained, experienced authority for each and every aspect of the broad water resources field.

The project made possible a close and important liaison with the Missouri River Basin Commission. The Commission, formed in July 1972 with representation from state and federal water agencies, is the focal point for water resources planning. Their comprehensive framework study, a continuing endeavor, enables planners and developers to perceive future needs for knowledge in advance of the need. This is an essential step in programming effective research.

### REGIONAL RESEARCH WORKSHOP CONCEPT

The Consortium used the workshop approach in the identification of high priority water problems. The initial workshop was held in Lincoln, Nebraska in June 1973 at which time twenty-three priority areas were identified. Subsequent evaluation in 1974 by the principal investigators caused ten priority areas to be analyzed in detail. The reports of the workshops which were held in the various states refined the specific research need and offered alternative solutions to the problems. These are reported in a March 1975 publication entitled "Identification and Analysis of Selected High Priority Water Problems and Related Research Needs of the Missouri River Basin".

Subsequent to this effort, the Consortium exerted a continuing effort in identifying high priority water problems. Problem areas were identified in accordance with a matrix classification formulated by the Office of Water Research and Technology (Department of the Interior). This report includes the water research priorities for the Missouri River Basin states as determined for fiscal year 1978. It is expected that this is not the final effort, but continuing updating will be necessary.



REGIONAL  
WATER RESOURCES PROBLEMS  
AND  
RESEARCH BUDGET NEEDS



WATER RESOURCES RESEARCH PRIORITIES  
FOR  
THE MISSOURI RIVER BASIN STATES  
FISCAL YEAR 1978

A cooperative Water Resources Research Program was established in each of the Missouri River Basin States following passage of the Water Resources Research Act of 1964. Since the initiation of this program both practical and basic research on various water problems have been conducted. There are many examples where a single state research study has shown dollar return greater than the entire cost of the total of individual state expenditures. The institutes have worked closely with both state and federal agencies. Recently there has been major emphasis on regional water problems. This thrust has pointed to the most efficient use of available funds and studies on most important problems. Closer coordination of efforts between the Office of Water Research and Technology (Department of the Interior) and the states has resulted in the designation of eight regions. These regional groups assist in outlining the research areas where water problems are the most critical. This report outlines regional problems of the Missouri River Basin where funds are needed in fiscal year 1978. The Classification Matrix (Form OW-417) and Problem Projection (Form OW-418) were prepared by the Office of Water Research and Technology and was used by all of the states in the Missouri Basin. A summary is included with the results of this report.

The Missouri River Basin covers one-sixth of the contiguous United States and is the largest of the OWR<sup>TM</sup> regional groupings. It includes all or part of 10 states. (This report covers data from Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, South Dakota and Wyoming.) Rainfall varies from over 40 inches in the eastern part to only 10-15 inches annually in the western portion. Uneven distribution of rainfall contributes to summer droughts, and most of the major streams produce flood problems, either from excessive precipitation events or rapid snow melt.

In the western portion of the basin water supplies are fully utilized and over appropriation deserves additional study. There is competition for water for irrigation-energy developments, new industries and recreation. Agriculture is the major user of water, although large urban centers are developing and industry is growing--where water supplies will permit. In the higher rainfall areas, (eastern portion), periodic summer droughts are stimulating supplemental irrigation of grain and forage crops. High costs of machinery and farm operations jeopardize the farm investment when lack of precipitation reduces crop yields.



This region produces most of the nation's wheat and large quantities of other grains including corn and soybeans. Livestock production, meat packing and food and grain processing are major industries. These agribusinesses require large amounts of water, and treatment of wastes to prevent stream pollution. Current requirements of PL 92-500 regarding non-point sources of pollution affect most of the farms. There are extensive areas of grazing land. The region has long conducted research on soil erosion--to save soil for the future. Emphasis has now shifted to the study of sediment as the major water pollutant. Sediment may be the primary carrier of other pollutants, which adhere to soil particles in suspension. Fertilizers and farm chemicals are extensively used in grain production. The fate and contribution of these materials to water pollution are largely unknown and practical research is needed to achieve results which can lead to improved management practices.

The water supplies in the Missouri Basin states figure prominently in the national energy picture. Wheat is the principal commodity for export to pay for foreign oil. Corn and soybeans are also important export items. These export commodities are critical in maintaining a favorable balance of trade. Major U.S. deposits of coal and oil shales are in this area. A limited amount (or distant location) of water supplies is a constraint on technology. Relationships of extensive uranium and lead deposits with water supplies are also of concern. Research is required to best utilize limited water supplies in the basin to attain national self-sufficiency in energy and mineral supplies.

#### WATER RESOURCES PROBLEM PROJECTION

Directors of the Water Resources Centers and Institutes of the Missouri Basin States have worked with the local state and federal agencies in projecting future needs for water studies. The table on page 8 is a summary of data from the OW-417 forms, prepared by individual states, showing a classification of problems listed as "critical or severe." Summaries of all states at two levels of allotment funding (\$110,000 and 250,000 annually) and three levels of matching support (\$50, \$150,000 and available non-federal funds) are listed in tables, pages 9 through 13.

These summaries show that all four of the problem areas are of regional importance. There are only small differences in percentage allocation of proposed funding for 1978 at the two levels of allotment funding. About 60 percent is listed for Water Quantity and Water Quality Problems. Environmental Impact and Water Planning and Management are considered important in





most states, with a slightly larger percentage of increased funds to be used for the former.

At the lowest level of matching funds 44.1 percent is suggested for studies of Water Quality, pointing to problems in the low rainfall areas, and the effects of coal and oil shale developments on water pollution. Water Planning is listed as only 12.8 percent at this lowest level of matching funds. At the higher level of matching funds a larger percentage is designated for Water Planning and Management. Although there are some differences in emphasis in the eastern and western extremes of the basin, major regional problems are considered to be in the area of Water Quantity. At low levels of funding Water Quality is also of high priority. Should additional research funding be provided a larger percentage will be devoted to Environmental Impact and to Water Planning and Management research needs.

#### PRIORITY AREAS

##### I. WATER QUANTITY

###### A. Control of Excess Water

Three states in the eastern portion of the Basin (Iowa, Kansas and Missouri) consider flooding and management of excess water major problems. Most precipitation occurs from April to September and some storms are heavy. Correlation between precipitation and flooding is not exact, but the problem is the greatest in the lower part of the basin. Flood problems include the need for studying flood plain management implementation strategies in a social--economic--institutional framework, evaluating the impact of urbanization, potential need for additional agricultural drainage improvements, channel stabilization and bank erosion problems and the physical erosion potential under high-level agricultural production. In the western areas where rainfall is low, or where a major portion of the available water is from snow-melt, excess water is an infrequent problem.

###### B. Water Supply Augmentation and Conservation

This is a problem area given high priority by all of the states in the basin. In the western portion there is a deficiency of water and most available supplies are fully allocated. There are areas where ground water depletion is serious. Coal and oil shale developments require water. Urban and industrial developments are limited by existing water supplies. There is much concern for increased future demands. There is much interest in basin transfer. Increased upstream demands for irrigation and requirements



for coal processing are reducing (and will continue to reduce) the flow of the lower Missouri. Large transportation and waste disposal are affected. In the eastern portion, frequent summer drouths jeopardize crop production. Interest in supplemental irrigation is growing. There is interest for utilizing flood water during periods of drouth or transferring river water to border or interior counties. Additional studies of water allocation throughout the basin are needed.

## II. WATER QUALITY

### A. Control of Entering Pollutants

All eight states listed need for research on pollution problems (particularly non-point sources) as they apply to both surface and ground waters. Losses and fate of farm chemicals and fertilizers to water supplies are considered problems by most states. Other water quality problems are created by erosion, sediments, logging operations, cattle grazing and various coal and other mining operations. States in the lower rainfall areas have questions regarding natural sources of salts (saline seeps), flow irrigation problems, and seep areas developing from the construction of large reservoirs. To meet the requirements of PL 92-500 there is need for information on the use of sewage effluent for crop irrigation, and for land disposal of both urban and agricultural (livestock) organic waste residues.

### B. Effects of Pollutants

There are many unanswered questions on the effect of various pollutants. Problems differ from those in other sections of the nation. Sediment as a pollutant deserves additional attention. Biological effects of farm chemicals on Missouri basin lakes and closed basins are largely unknown. Many shallow aquifers have been the source of domestic supplies when lower depths are too highly mineralized for domestic use. Coal developments pose an unknown for areas with limited supply or where the existing water being used is of inferior quality. Land management is changing and there is little basic information on the influence of man's activities on water quality.

### C. Water Treatment Processes and Disposal of Wastes

Most concern in this problem area is related to requirements of PL 92-500. Population of the area is much less than in the states east of the Mississippi River. However, major effort is being made to improve the quality of the Missouri River. There is need for information that will permit the



use of sewage effluent and water treatment wastes to be efficiently applied to agricultural land. In the region where evaporation exceeds precipitation the quality of irrigation return flow is of major concern.

### III. ENVIRONMENTAL IMPACT

#### A. Economic Effects

Emphasis in this problem area is generally associated with large reservoirs. There are conflicts between citizens who want to emphasize recreation, and those interested in other beneficial uses such as flood control, water supply and fish and wildlife propagation. Criteria other than economic values need to be developed and evaluated. There is a lack of sound information for the preparation of impact statements on new projects that are in the planning stages. Studies are needed to provide information on the usefulness of multipurpose reservoirs, and problems that may develop. Because of the high nutrient contents of sediments, the erosiveness of some soils and the economy in the basin, data from other parts of the nation are of only limited value.

#### B. Ecosystem Effects

Most states listed ecosystem effects as an area where information was needed, but largely as a lower priority area than where water quantity or quality is concerned. Many of the specific problems are related to seeps and return irrigation flows to larger reservoirs. There is a lack of knowledge on the biological effects of different materials on the lakes. There is public interest on improvement of the Missouri River. However, the input of those participating in this evaluation considered this problem to require long-time effort and assigned it a lower priority.

#### C. Public Welfare Effects

Future energy-water relations in the Missouri Basin States will have national implication. The Missouri Basin people have the same concerns and problems as in more populated areas-- particularly near the larger towns. There is general appreciation for "wide open spaces" and natural conditions, with increased economic growth being subordinated by many citizens. Since water resources are critical throughout the region there is demand for in-depth studies that will permit economic growth, but provide recreation and preserve the best natural conditions. Of particular concern is the development of energy reserves and maintain the food production potential. It is just being recognized that public water



supply districts, to bring quality water to farm areas, is having environmental impacts far beyond the health of farm people or providing livestock water. Questions raised about this influence in population shifts from urban areas is a subject where there are few facts.

A shorter work week, in addition to gasoline shortages and increased prices, has stimulated interest of the basin people in water recreation closer to home. Additional information is needed for the management of water resources that will provide for the greatest good without degrading some natural conditions. There is much local sentiment that this region profit from the experiences of areas with greater populations and more industrial development. However, much data now in existence (from other areas) is of limited value without studies to incorporate the different environmental conditions that exist.

#### IV. WATER PLANNING AND MANAGEMENT

##### A. Institutions; B. Methods and Procedures; and C. Basin Data

Water planning and management varies widely from state to state. Some have active planning programs, while others have done little, and in some states there is public opposition to rigid programs. The individual state comments (appendix) list numerous areas where information is needed. It is evident that lack of basic data, the variation in water resources problems within this vast area, and methods that will meet general public acceptance have hindered planning. All of the states have listed work in this area as needed, with special attention being given to assisting each state's resource agencies in comprehensive planning programs. Information dissemination and publication distribution are key needs in the planning coordination phase. As each state complies with the comprehensive planning requirements, coordinated by the Water Resources Council, through the basin organizations, the role of the institute as a research arm will ever be more evident.





## SUMMARY OF MATRIX EVALUATION

An evaluation was made of priorities and research needs, using the OWRT Form OW-417. The water research classification matrix for each institute was combined in a weighing process to evaluate the basin results. A value of 2 was assigned to each "critical" designation in the matrix, and a value of 1 to each "serious" designation. The values were then summed for the eight states in the Missouri basin. The results are listed in the matrix as shown in the accompanying sheet.

In terms of problem areas, the matrix shows that the following water resources problem areas have highest priority:

1. Water supply augmentation and conservation
2. Control and effects of pollution
3. Ecosystems effects
4. Methods and procedures for planning and management

In terms of the research systems and processes, the following listing shows the hydrologic, biological, sociological, planning & management, engineering, and data acquisition items of greatest importance. These are:

1. Water-soil interface
2. Channel flow
3. Groundwater, including wells and recharge systems
4. Watershed, river, and lake ecosystems
5. Biochemical impacts
6. Economic factors
7. Legal factors
8. Problem identification, plan evaluation, and decision making
9. Water treatment (believed to be related to renewed concern with drinking water standards)
10. Water supply engineering
11. Eutrophication control
12. Irrigation
13. Hydrologic, biologic, and sociological data acquisition, and information systems

Examination of the matrix, in detail, permits one to identify specific research needs. For instance, water treatment and methods and procedures of analyzing the economic impact of water resources are the research items receiving the greatest priority, each having a weight of 11. Other key but specific research areas are also evident. However, the matrix is more valuable in a broader sense, as outlined above.

Therefore, it can be concluded that several areas of importance have been identified, and research needs are broadly but clearly defined. Values above 4 (from 4 to 11) might be considered the highest priority needs. Thus a research direction is provided for the institutes in the MRBWIC group. These results will enable MRBWIC directors to develop an expanded regional research program, with the assistance and cooperation of the federal Office of Water Research and Technology.







NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS  
 WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$110,000 Allotment

Iowa  
 Kansas  
 Missouri  
 Montana  
 Nebraska  
 North Dakota  
 South Dakota  
 Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	Percent	
										A	M*
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	20	23.5		10			15		68.5	7.8	4.7
B. Water Supply Augmentation and Conservation	10	39.3	10	50	10	10	15	20	164.3	18.6	14.6
C. Water Utilization					30				30	3.4	9.6
D. Water Allocation								20	20	2.3	1.6
E. Instream Flow								10	10	1.2	1.6
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants		15.1	15	10		10	20	10	80.1	9.1	10.2
B. Effects of Pollution	20	11.1	10	10	15	30	10	10	116.1	13.3	10.4
C. Water Treatment Processes and Disposal of Wastes	10	5	20	5	10	10	5		65	7.4	7.0
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	10		5	10	5	10	5	10	55	6.2	10.0
B. Ecosystems Effects	20	11	10	5	10	15	10	10	91	10.3	12.1
C. Public Welfare Effects			10		5	10	5		30	3.4	4.6
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	20		10	5	5		10	10	60	6.8	4.8
B. Methods & Procedures		5	10	5	15	10	15	10	70	7.9	6.7
C. Basic Data			10		5	5			20	2.3	2.1

Dollars in thousands (,000 - omitted)

\*Based on \$150,000 of matching money.



NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS  
 WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$250,000 Allotment

Iowa  
 Kansas  
 Missouri  
 Montana  
 Nebraska  
 North Dakota  
 South Dakota  
 Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	Percent	
										A l l o t m e n t	M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	20	44	20	20		20	40		164	8.2	2.9
B. Water Supply Augmentation and Conservation	30	59	30	100	20	20	30	40	329	16.5	25.2
C. Water Utilization					80				80	4.0	12.5
D. Water Allocation								30	30	1.5	2.5
E. Instream Flow								20	20	1.0	
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants	30	40	30	30		30	30	10	200	10.0	5.6
B. Effects of Pollution	30	15	30	30	35	40	20	20	220	11.0	12.5
C. Water Treatment Processes and Disposal of Wastes	25	25	30	10	30	20	10	10	160	8.0	3.8
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	25	13	10	20	10	20	20	25	143	7.1	10.0
B. Ecosystems Effects	30	17	20	15	15	50	30	20	197	9.8	11.4
C. Public Welfare Effects	10	7	20	5	10	20	10	10	92	4.6	1.1
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	20	10	20	5	10	10	30	15	120	6.0	5.0
B. Methods & Procedures	20	20	20	10	30	10	30	40	180	9.0	7.5
C. Basic Data	10		20	5	10	10		10	65	3.3	0

Dollars in thousands (,000 - omitted)

\*Based on \$50,000 matching.





NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS  
WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$50,000 Matching

Iowa  
Kansas  
Missouri  
Montana  
Nebraska  
North Dakota  
South Dakota  
Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A* l l o t m e n t	M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water		11.5							11.5	4	1
B. Water Supply Augmentation and Conservation	15	15.5	5	40			15	10	100.5	8	6
C. Water Utilization					50				50		1
D. Water Allocation										1	
E. Instream Flow								10	10	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants		7.5	10				5		22.5	6	3
B. Effects of Pollution	15	5	10			10	10		50	8	5
C. Water Treatment Processes and Disposal of Wastes		5	10						15	7	2
III. ENVIRONMENTAL IMPACT											
A. Economic Effects						20	10	10	40	7	3
B. Ecosystems Effects	10	5.5				20		10	45.5	8	4
C. Public Welfare Effects			5						5	5	2
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	10						10		20	6	2
B. Methods & Procedures			10	10				10	30	7	2
C. Basic Data										3	0

Dollars in thousands (,000 - omitted)

\*Based on \$110,000 of allotment money.



NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS  
 WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

\$150,000 Matching

Iowa  
 Kansas  
 Missouri  
 Montana  
 Nebraska  
 North Dakota  
 South Dakota  
 Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A*	M
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	10	25.5					10	10	55.5	6	4
B. Water Supply Augmentation and Conservation	20	40	20	50			25	20	175	8	6
C. Water Utilization					115				115	1	2
D. Water Allocation								20	20	1	1
E. Instream Flow								20	20	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants	20	21.5	25	30			15	10	121.5	7	6
B. Effects of Pollution	20	15	15	20		25	20	10	125	8	7
C. Water Treatment Processes and Disposal of Wastes	15	15	20			25		10	85	8	5
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	15	5	10	20	20	20	20	10	120	8	8
B. Ecosystems Effects	15	10	10	20		50	20	20	145	8	7
C. Public Welfare Effects	5	5	15			30			55	8	4
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	10	3	15	10			20		58	8	5
B. Methods & Procedures	15	10	10		15		20	10	80	8	6
C. Basic Data	5		10					10	25	6	3

Dollars in thousands (,000 - omitted)

\*Based on \$250,000 allotment.



NATIONAL ASSOCIATION OF WATER INSTITUTE DIRECTORS  
 WATER RESOURCE BUDGET PROJECTION FOR FISCAL YEAR 1978

Region: Missouri River Basin

Date: December 1975

State Institutes:

Maximum State Matching

Iowa  
 Kansas  
 Missouri  
 Montana  
 Nebraska  
 North Dakota  
 South Dakota  
 Wyoming

	I o w a	K a n s a s	M i s s o u r i	M o n t a n a	N e b r a s k a	N D a k o t a	S D a k o t a	W y o m i n g	T o t a l	States Involved	
										A* l l o t m e n t	M a t c h i n g
PROBLEM AREAS											
I. WATER QUANTITY PROBLEMS											
A. Control of Excess Water	15	76.5	10	75			50	10	236	6	6
B. Water Supply Augmentation and Conservation	35	120	20				30	50	255	8	5
C. Water Utilization					242				242	1	1
D. Water Allocation								50	50	1	1
E. Instream Flow								30	30	1	1
II. WATER QUALITY PROBLEMS											
A. Control of Entering Pollutants	25	64.5	40	30		25	30	10	224	7	7
B. Effects of Pollution	40	45	30	30		75	20	20	260	8	7
C. Water Treatment Processes and Disposal of Wastes	40	45	30	10		25	10		160	8	6
III. ENVIRONMENTAL IMPACT											
A. Economic Effects	35	15	15	30		75	50	20	240	8	7
B. Ecosystems Effects	25	30	20	40		100	40	50	305	8	7
C. Public Welfare Effects	15	15	15	10		75	10	10	150	8	7
IV. WATER PLANNING & MANAGEMENT											
A. Institutions	30	9	20	10			30	20	119	8	6
B. Methods & Procedures	25	30	20	20	75	15	20	10	215	8	8
C. Basic Data	15		10	10	53	10	10	50	158	6	7
Total	300	450	230	265	370	400	300	330	2,645		

Dollars in thousands (,000 - omitted)

\*Based on \$250,000 of allotment money.



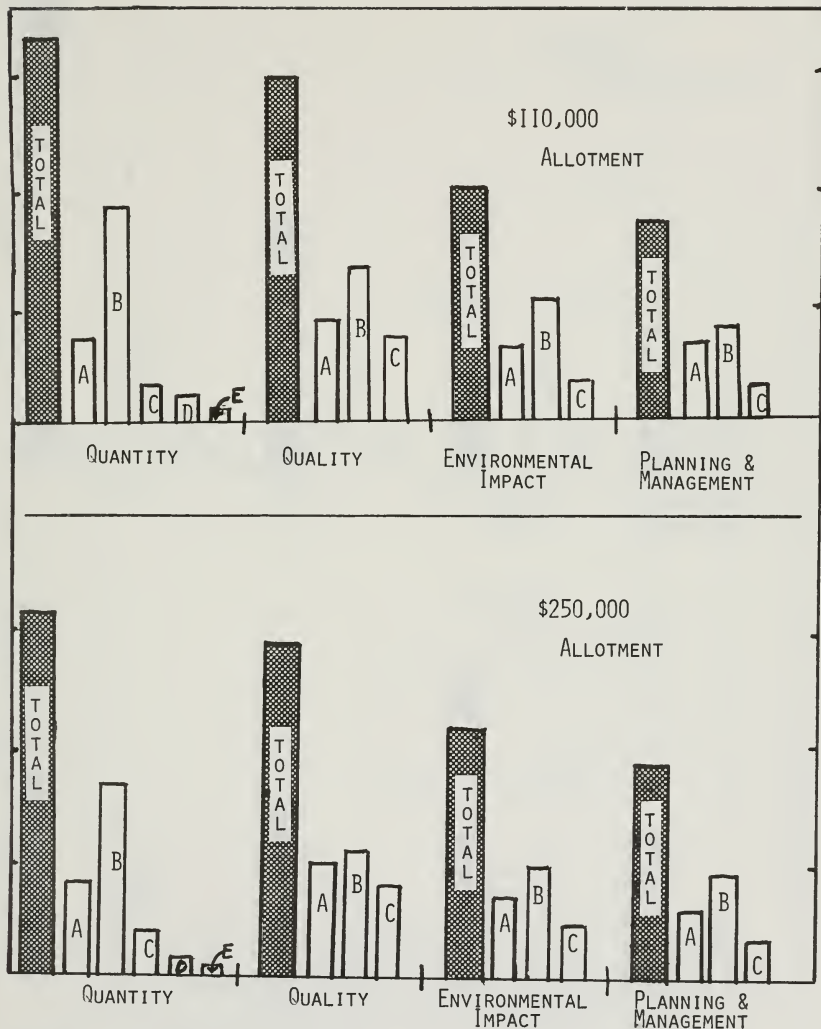


FIGURE I PROJECTED BUDGET DISTRIBUTION FOR FY 1978 BY PROBLEM AREA CATEGORIES FOR TWO LEVELS OF ALLOTMENT FUNDS





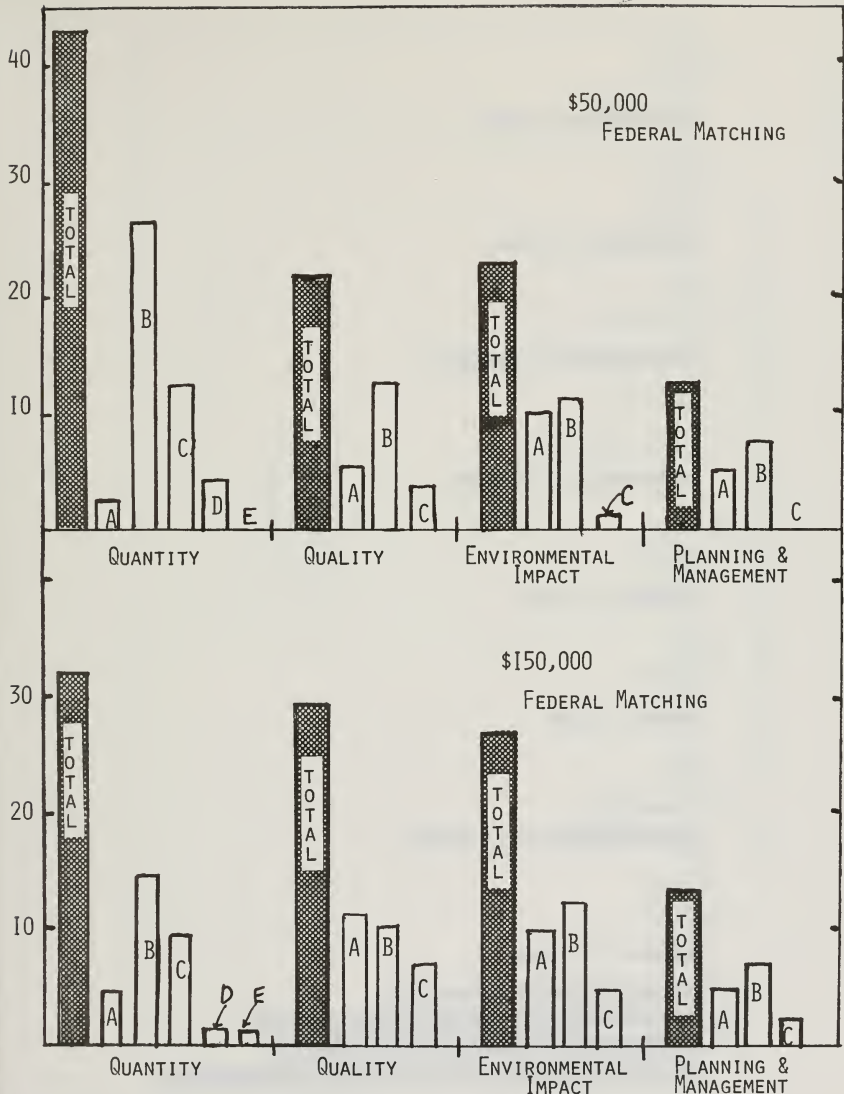


FIGURE II PROJECTED BUDGET DISTRIBUTION FOR FY 1978 BY PROBLEM AREA CATEGORIES FOR TWO LEVELS OF FEDERAL MATCHING FUNDS



Figure 1: Comparison of two bar charts showing a bell-shaped distribution of data points. The top chart shows a distribution with a peak at the center, and the bottom chart shows a similar distribution with a slightly different peak position.

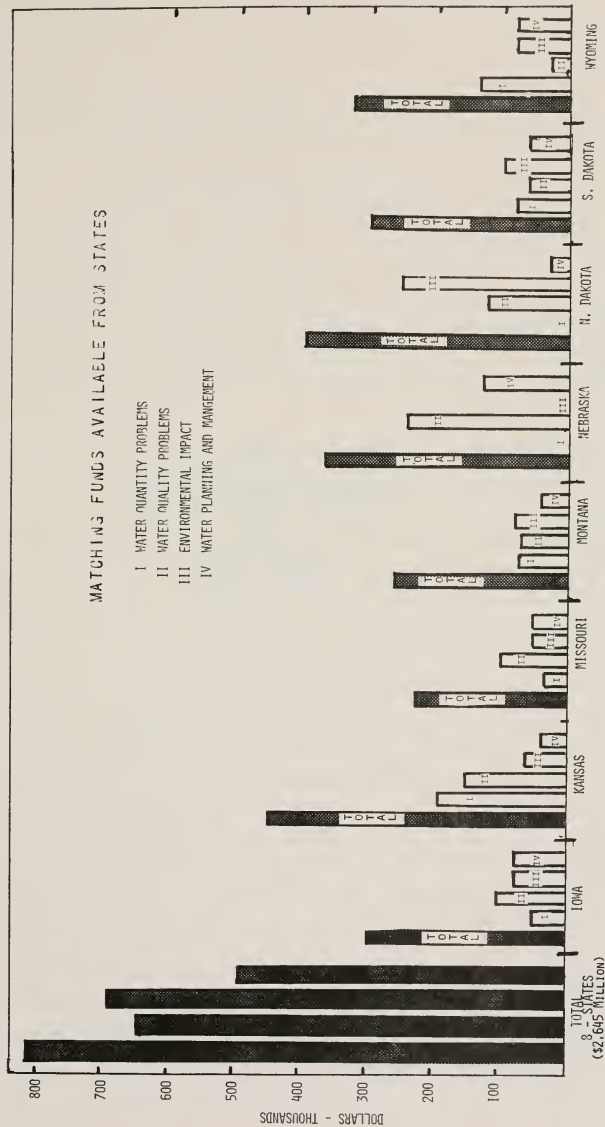


FIGURE 3. PROJECTIONS OF MATCHING FUNDS, BY STATES, AVAILABLE FOR WATER RESOURCES RESEARCH IN FY 1978

DOLLARS - THOUSANDS



IOWA'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

MERWIN D. DOUGAL, DIRECTOR  
IOWA STATE WATER RESOURCES  
RESEARCH INSTITUTE



IOWA STATE WATER RESOURCES RESEARCH INSTITUTE  
FY 1978 Research Budget Needs and Projections

IOWA -- CRITICAL WATER PROBLEMS

1. Impact of floods as excess water

Flood problems continue to beset the state. Identified problems include the need for studying flood plain management implementation strategies in a social-economic-institutional framework, evaluating the impact of urbanization, potential need for additional agricultural drainage improvements, channel stabilization and bank erosion problems and the physical erosion potential under high-level agricultural production.

2. Supply availability problems and augmenting existing supplies

Research needs have been identified in several key areas. These include the need for augmenting and providing additional water supplies for southern and western Iowa. Supplemental irrigation demand may create problems along the border and the major interior streams having wide alluvial flood plains. The transfer of water from the border rivers into the border and interior counties may become a real need in view of the current drought potential. The allocation of the waters of the Missouri River also is of great interest to Iowa, and evaluation of the impact of upstream demands for irrigation and energy must be made.

3. Meeting beneficial water use requirements

Allocation of water in Iowa, among the recognized beneficial use groups, will become an important factor in state water planning. Allocation or control of the piezometric head in groundwater aquifers is a key problem that now faces the state. Additional study of the need for and impact of increased demands for municipal, industrial, and energy uses and their competition with recreation and other uses has been outlined through problem analysis. Eight beneficial user groups are included in the current Iowa framework study for water planning: water use by municipal, industrial and rural regional; agricultural needs; flood plain management; water quality enhancement; outdoor recreation; fish and wildlife improvement; water for energy production; and navigation and river transportation.

4. Groundwater quality protection

Groundwater quality in Iowa has deteriorated in many locations. The impact of leachates from solid-waste disposal sites is of special interest as relatively new state regulations are implemented. Many problems also have been encountered in areas where rural residential





growth has been accelerated. Study of management systems and technical factors associated with individual household waste disposal systems is just underway, and a 5-year need has been outlined. Drainage wells exist in northern Iowa, and their impact has never been studied in detail. Loss of well pumping capacity with time is another chronic problem facing the owners of water wells, and improved well design is a new objective.

5. Erosion and sediment control in Iowa

The land erosion potential under high level agricultural production is staggering. The ability of erosion and sediment control programs to solve the problem is seriously challenged by the introduction of large scale farming equipment through high level technology. A multidisciplinary technical-social-economic-institutional study of the problem is dictated by the complex nature of the problem.

6. Water quality enhancement and pollution control

The impact of point and non-point source pollution on Iowa's streams and lakes is great. Low flow characteristics of Iowa's streams are poor, except for the far northeast part of the state. Management programs of several types have been proposed for study. Additional technical, social, and economic interrelationships need to be included in the proposed investigations. Key management programs have been outlined for: non-point source pollution; lake management; reservoir water quality improvement; and in water pollution control. Advanced waste treatment at point pollution sources requires further study, as energy and material problems make previous solutions unacceptable to municipal and industrial leaders, or difficult to implement under current funding limitations. Management and control of non-point source pollution will involve both agricultural and non-agricultural sources. Technical, social and economic factors must be evaluated to determine the management level which will best serve the state.

7. Environmental impact of water resources development

The usefulness of the large multipurpose reservoirs in Iowa is being identified and evaluated in research studies. The technical studies now being made need to be supplemented by social, economic, and institutional studies for further knowledge. Improved management programs will evolve from these studies. Additional application and in-depth studies of recreation demand and economic benefits gained by nearby communities also have been requested by state and federal agencies. The environmental impact of other water resources facilities and from the several beneficial water use groups also warrants attention. These include studies of Iowa's key recreation lakes as well as the major border rivers, the Missouri and Mississippi Rivers.

THE UNIVERSITY OF CHICAGO  
DEPARTMENT OF CHEMISTRY  
5800 S. UNIVERSITY AVENUE  
CHICAGO, ILLINOIS 60637  
TEL: (773) 835-3100

RESEARCH INTERESTS  
IN THE FIELD OF  
ORGANIC CHEMISTRY  
AND  
BIOCHEMISTRY  
ARE INVITED  
TO APPLY FOR  
POSITIONS  
AS  
POSTDOCTORAL  
FELLOWS  
OR  
ASSISTANT  
PROFESSORS  
IN  
THE  
DEPARTMENT  
OF  
CHEMISTRY  
AT  
THE  
UNIVERSITY  
OF  
CHICAGO

APPLICANTS SHOULD  
SEND  
A  
LETTER  
OF  
INTEREST  
AND  
A  
CURRICULUM  
VITAE  
TO  
THE  
DEPARTMENT  
OF  
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UNIVERSITY  
AVENUE  
CHICAGO,  
ILLINOIS  
60637  
TEL:  
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8. Water resources management program in Iowa

Studies in the operations, planning and management area would be directed to several key areas. One is a proposed review of the Little Sioux River watershed management program that includes tributary small watershed projects and main-channel river improvements. A second planning and management study entails the regional operation of dispersed individual water pollution control plants, with centralized laboratory facilities as the first real need and general operation and systems management as further needs. The third area involves the development of regional (rural) water systems in Iowa. The fourth is need for the development, legislative enactment and implementation of water quality management districts in the recreation lake regions in Iowa. A fifth is a developing need for analysis of natural resource regions in Iowa, in a combined land-timber-mineral-water resource picture, and in a long term perspective.



IOWA STATE WATER RESOURCES RESEARCH INSTITUTE  
FY 1978 Research Budget Needs and Projections

<u>Problem Areas and Research Needs Descriptions</u>	<u>Coordinates of Critical/Severe Research Needs Associated With Problems</u>	
	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
1. Impact of floods, flood damage reduction in urban and agricultural areas, further implementation of statewide flood plain management program	I-A	I-B(s) I-C(c) III-A to E (s) IV-B, C, D(s) IV-E, F(c) V-D, J(s) V-H(c) VI-A, C(s)
2. Augmenting water supplies in areas deficient in moisture availability, surface water yield and having ground water quality problems	I-B	I-D(s) I-E(c) II-C(s) III-C(s) III-D, E(c) IV-A, E(s) IV-B, D(c) V-C, E(s) VI-A, D(s)
3. Meeting beneficial use requirements, including allocation of water in competing circumstances	I-B	I-E(c) II-C(s) III-C(s) III-D, E(c) IV-D, E(c) IV-E(s) V-A, E(s) VI-A-E(s)
4. Protection of groundwater quality through control of solid waste residues, of individual household waste disposal systems, and impact of trace pollutants and other non-point pollution sources	II-A          II-B	I-E(c) II-D(c) III-A, C(s) III-E(c) IV-A, C, D, E, F(s) V-A, C(s) I-B(s) III-B, D(s) I-E(c) V-C(s) II-B(s) VI-A-E(s) II-D(c)



Problem Areas and  
Research Needs Descriptions

Coordinates of Critical/Severe  
Research Needs Associated With Problems

	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
5. Land erosion potential under high level agricultural production and alternative management programs	II-A	II-B(s) IV-A,C,F(s) II-C,D(c) IV-B,D(c) III-A-C(s) V-G,H (c) III-D,E(c) V-J(s) VI-F(s)
	II-B	I-B,C,D(s) II-B(c) IV-H(s) II-C(c) VI-A-E(s) III-B,D(s) V-A,H(s)
6. Water quality improvement of surface-water streams and lakes, as impacted by point and non-point sources of pollution, and as might be improved through management programs and advanced waste treatment facilities	II-A	II-B(s) IV-A,C,F(s) II-C,D(c) IV-B,D(c) III-A-C(s) V-G,H(c) III-D,E(c) V-J(s) VI-F(s)
	II-B	I-B,C,D(s) II-B(c) IV-H(s) II-C(c) VI-A-E(s) III-B,D(s) V-A,H(s)
	II-C	I-D(s) IV-D(s) I-E(c) IV-E(c) II-D(c) V-B,C,E(s) III-D(s) VI-D(s)
7. Environmental impact assessment and beneficial use of the large multipurpose reservoirs in Iowa, and of other multipurpose water resources programs	III-A	I-E,F(s) IV-D(c) III-C,E(s) V-D,E,F(s) III-D(c) V-G,H,J(c) IV-B,E,F(s) V-I(s)
	III-B	I-C,D(s) V-D,H,J(s) I-E(c) V-G(c) II-B,C(s) VI-A,F(s) II-D(c) VI-B,C(c) III-A(s)
	III-C	III-A,B,C(s) III-D,E(c) IV-A,C(s) VI-C,F(s)





Problem Areas and  
Research Needs Descriptions

Coordinates of Critical/Severe  
Research Needs Associated With Problems

	<u>Problem Area(s)</u>	<u>Research Classification Coordinate</u>	
8. Management program evaluation and needs, for (a) selected watershed management systems; (b) regional operation of dispersed individual water pollution control plants, (c) rural-regional water supply systems; and (d) state water plan needs	IV-A	I-E(s) III-A(s) III-D,E(c) IV-A,D,E(s) IV-B(c)	IV-F(c) V-B,H,J(s) V-E,G(c) VI-C(s)
	IV-B	I-B(s) I-C(c) III-A,B,C(s) III-D,E(c)	IV-B,D,E(s) V-B,H,J(s) V-E,G(c) VI-C(s)
	IV-C	I-C(s) I-E(c) II-B,C(s) II-D(c)	V-C,E,I,J(s) VI-B,C,E,F(s)







OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

## WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: IOWA STATE WATER RESOURCES RESEARCH INSTITUTEREGION: MISSOURI BASINDATE: 10-10-75

For FISCAL YEAR 1978

PROBLEM AREAS	Allotment		Matching			TOTAL
	\$110*	\$250*	\$50*	\$150*	\$300*	
<b>I. WATER QUANTITY PROBLEMS</b>						
A. Control of Excess Water	20	20	--	10	15	
B. Water Supply Augmentation and Conservation	10	30	15	20	35	
<b>II. WATER QUALITY PROBLEMS</b>						
A. Control of Entering Pollutants	--	30	--	20	25	
B. Effects of Pollution	20	30	15	20	40	
C. Water Treatment Processes and Disposal of Wastes	10	25	--	15	40	
<b>III. ENVIRONMENTAL IMPACT</b>						
A. Economic Effects	10	25	--	15	35	
B. Ecosystems Effects	20	30	10	15	25	
C. Public Welfare Effects	--	10	--	5	15	
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>						
A. Institutions	20	20	10	10	30	
B. Methods & Procedures	--	20	--	15	25	
C. Basic Data	--	10	--	5	15	
<b>Total</b>	<b>110</b>	<b>250</b>	<b>50</b>	<b>150</b>	<b>300</b>	

## CLASSIFICATION LEGEND

C - Critical

S - Severe



KANSAS  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

WILLIAM L. POWERS, DIRECTOR  
WATER RESOURCES RESEARCH INSTITUTE





CRITICAL PROBLEMS OF THE STATE OF KANSAS

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
<p>1. <u>Flood Frequency Predictions from Heavy Summer Thunderstorms</u></p> <p>In all parts of the state about 75% of the precipitation occurs between April and September. Summer thunderstorms in excess of 5 inches of rainfall have been recorded in nearly every part of the state. Although rainfall is the primary cause of floods, there is no exact correlation between rainfall amount and flood discharge. Analysis of flood frequency data along with prediction models will help control the damaging effects of heavy rainfall.</p>	I-A	I-C II-A III-S
<p>2. <u>Improving Water Use Efficiency</u></p> <p>Municipalities, industry and agriculture all utilize groundwater, but irrigation is by far the greatest user of water in Kansas. Groundwater use is predicted to rise from 2.4 maf in 1965 to 8.0 maf in 2000 with agriculture utilizing 90% of the withdrawal. During the same period municipal and industrial use of groundwater is expected to grow 270%. During this interval, surface water withdrawals will change from 1.1 to 6.2 maf annually. Depletion of groundwater reserves results from over-pumping. These reserves may be essentially depleted in 4 counties by 2000 and in 19 counties by 2050. It is therefore important that research be done on conservation methods of increasing water use efficiency for both industry and agriculture.</p>	I-B	I-C I-E IV-D
<p>3. <u>Allocation and Management of Water</u></p> <p>Water quantity is a serious research area in the state of Kansas. Planning and management needs exist for the use of scarce quantities of water. Allocation of surface impoundment water has become an important question in the state of Kansas. Pricing practices and groundwater aquifer management will become serious research problems in the near future. Therefore, additional research is needed on pricing and allocation methods for water in the state of Kansas.</p>	IV-B	I-C I-E II-A II-B III-D V-B V-E



RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	I. HYDROLOGICAL		II. BIOLOGICAL			III. SOCIOLOGICAL			IV. PLANNING & MGT.			V. ENGINEERING						VI. DATA ACQUISIT.																						
	Water-Soil Interface	Channel Flow	Lakes, Estuaries	Groundwater	Ice, Permafrost	Watershed Ecosystems	River Ecosystems	Lakes, Estuaries	Bio-Chemical	Political Action	Public Information	Goal Indicators	Economic	Legal	P&M Organizations	Problem Identification	Action, Design	Plan Evaluation	Decision-Making	Operations	Construction	Water Treatment	Wells, Recharge Sys.	Flood Protection	Water Supply	Navigation	Eutrophication Control	Brosion, Sed. Control	Irrigation	Watershed Improvement	Hydrologic Data	Sociologic Data	Engineering Data	Information Storage	Transfer Systems					
I. WATER QUANTITY	A	B	C	D	E	F	A	B	C	D	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F						
	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S			
A. Control of Excess Water																																								
B. Water Supply Augmentation and Conservation																																								
II. WATER QUALITY																																								
	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S		
A. Control of Entering Pollutants																																								
B. Effects of Pollution																																								
C. Water Treatment Processes and Disposal of Wastes																																								
III. ENVIRONMENTAL IMPACT																																								
	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
A. Economic Effects																																								
B. Ecosystems Effects																																								
C. Public Welfare Effects																																								
IV. WATER PLANNING & MANAGEMENT																																								
	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	
A. Institutions																																								
B. Methods & Procedures																																								
C. Basic Data																																								

CLASSIFICATION LEGEND:  
 C - Critical  
 S - Severe



FORM GW-410  
(7/75)

OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE:           Kansas          

DATE: Sept. 1975

REGION:           Missouri River Basin          

FISCAL YEAR 1978

PROBLEM AREAS	Allotment		Matching			TOTAL
	110,000	250,000	50,000	150,000	unlimited	
<b>I. WATER QUANTITY PROBLEMS</b>						
A. Control of Excess Water	23,500	44,000	11,500	25,500	76.5	
B. Water Supply Augmentation and Conservation	39,300	59,000	15,500	40,000	120	
<b>II. WATER QUALITY PROBLEMS</b>						
A. Control of Entering Pollutants	15,100	40,000	7,500	21,500	64.5	
B. Effects of Pollution	11,100	15,000	5,000	15,000	45	
C. Water Treatment Processes and Disposal of Wastes	5,000	25,000	5,000	15,000	45	
<b>III. ENVIRONMENTAL IMPACT</b>						
A. Economic Effects		13,000		5,000	15	
B. Ecosystems Effects	11,000	17,000	5,500	10,000	30	
C. Public Welfare Effects		7,000		5,000	15	
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>						
A. Institutions		10,000		3,000	9	
B. Methods & Procedures	5,000	20,000		10,000	30	
C. Basic Data						
TOTAL					450	

CLASSIFICATION LEGEND

C - Critical

S - Severe



MISSOURI'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

GEORGE E. SMITH, DIRECTOR  
WATER RESOURCES RESEARCH CENTER





PROBLEM AREAS:

I. Reduction of Flooding and Conserving Water for Supplemental Irrigation:

Average rainfall in Missouri is in excess of all needs. Floods are common on both the Missouri and Mississippi Rivers in many years. However, in many seasons, within a few weeks after heavy runoff summer crop production is jeopardized by seasonal moisture deficiency. The demand for grains in foreign exchange and the high cost inputs in crop production point to the need for preventing runoff during periods of floods and storage for use as supplemental irrigation in rainfall deficient periods. Competition is developing between agriculture, urban areas and recreational use for water supplies in some areas. Adequate river channel depths for barge transportation and increased requirements for new energy developments are future water quantity problems.

II. Non-point and Point Sources of Water Pollution:

Provisions of Public Law 92-500, concerned with non-point sources of water pollution are of much concern to Missouri farm people. As the demand for food production is emphasized the use of farm chemicals in Missouri will continue to grow. Additional information is needed on the fate of farm fertilizers and pesticides. How much of these materials is from urban areas and how much is from farm land? Feed-lot runoff (and grazing land), crop and mining residues must be associated with soil erosion (both rural and urban) to prevent stream degradation that must be evaluated with needed economic development. New waste water and water treatment residue disposal regulations are increasing costs. There is concern for the necessity of these requirements. Land use patterns are rapidly changing the quality of runoff water. These amounts must be understood. Point sources of contamination are better documented than non-point, but much information now being used is largely opinions--not facts.

Underground water supplies differ widely in quality depending on the area and the depth of the aquifer. There is concern about surface leachates (mostly rural areas) on shallow aquifers where deeper supplies are highly mineralized. Missouri is a major mining state. There is much concern for the effect of these operations on the quality of both ground and surface waters. Missouri has long been concerned about the role of trace substances in animal and human health. There is much interest in both the effect of the ions occurring naturally in water and substances that could enter from man's activities.



## Missouri - Critical Water Problems

Gasoline shortages are increasing the population pressure on the use of Missouri reservoirs and clear streams for recreation. Pollution from mining, urban areas and agricultural operations are largely unknown. There is need for information that will keep these water resources of highest quality for the people of the midwest.

### III. Land Use Changes and Water Resources:

There are varied interest groups with strong views on water resource developments in the state. In the northern part planned multiple purpose reservoirs cover some of the best agricultural lands. South of the Missouri River the naturalist, who wants to keep clear swiftly moving streams is opposed by reservoir enthusiasts and the need for hydropower and water supplies for urban and industrial use. When impact statements are prepared opinions rather than facts are frequently used in presenting economic, ecosystems and public welfare effects.

### IV. Water Planning and Management:

Missouri has done relatively little planning of water resources. Our larger cities obtain water from the rivers. New water quality laws require changes in water and waste water treatment and disposal. The state is affected by periods of excess rainfall--both within the state and runoff from states to the north and west. We need to manage water that causes floods and drainage problems so it will reduce flooding and can be utilized during summer drouths. There are sections of the state where multiple use lakes are needed that include provision for water recreation. A large part of the water in the Missouri River is from other states and the regulation of flow requires regional management. Additional research is required before adoption of a state water law.



RESEARCH NEEDSCoordinates of Critical/Severe  
Research Needs Associated With Problems

	Problem Area(s) Coordinate	Research Classification Coordinate*
I. Reduction of Flooding and Conserving Water for Supplemental Irrigation	I-B	I-E(s) II-C(s) III-B(s) III-D V-H V-J VI-F(s)
II. Non-Point and Point Sources of Water Pollution	II-A	I-C I-D II-A III-B III-C IV-E V-H V-I VI-B VI-F
	II-B	I-E V-E
	II-C	II-D(s) III-D(s) IV-C(s) V-B V-I
III. Environmental Impacts	III-A	I-C(s) V-J(s)
	III-B	I-C I-D III-B(s) V-I
	III-C	I-C I-D III-B(s) V-I



IV. Water Planning and Management

Problem Area(s) Coordinate	Research Classification Coordinate*
-------------------------------	-------------------------------------------

IV-A

III-S

IV-B

IV-E

IV-C

V-I





## RESEARCH WILL DEAL WITH THESE SYSTEMS &amp; PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES						VI. DATA ACQUISIT
	I. HYDROLOGICAL	II. BIOLOGICAL	III. SOCIOLOGICAL	IV. PLANNING & MGT.	V. ENGINEERING		
<u>PROBLEM AREAS</u>	A B C D E F Atmospheric Water-Soil Interface Channel Flow Lakes, Estuaries Groundwater Ice, Permafrost Watershed Ecosystems River Ecosystems Lakes, Estuaries Bio-Chemical	A B C D E F Political Action Public Information Goal Indicators Economic Legal	A B C D E F P&M Organizations Problem Identification Action, Design Plan Evaluation Decision-Making Operations	A B C D E F Construction	A B C D E F G H I J Water Treatment Wells, Recharge Sys. Flood Protection Water Supply Navigation Eutrophication Control Irrigation Watershed Improvement	A B C D E F Hydrologic Data	A B C D E F Engineering Data Information Storage Transfer Systems
<u>I. WATER QUANTITY</u>							
A. Control of Excess Water							
B. Water Supply Augmentation and Conservation	S	S S C	S S	S	C C	C	E
<u>II. WATER QUALITY</u>							
A. Control of Entering Pollutants	C C	C C	C C	C	C C	C C	C
B. Effects of Pollution	C						
C. Water Treatment Processes and Disposal of Wastes		S	S	S	C	C	
<u>III. ENVIRONMENTAL IMPACT</u>							
A. Economic Effects	S						
B. Ecosystems Effects	C	S S	S			C	
C. Public Welfare Effects	C C	S S	S			C	
<u>IV. WATER PLANNING &amp; MANAGEMENT</u>							
A. Institutions			S				
B. Methods & Procedures				S			
C. Basic Data							

CLASSIFICATION LEGEND:

C - Critical



OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

## WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: MissouriDATE: 10-1-75REGION: Missouri Basin

## FISCAL YEAR

PROBLEM AREAS	Allotment*		Matching*			TOTAL
	\$110	\$250	\$50	\$150	Unlimited	
<b>I. WATER QUANTITY PROBLEMS</b>						
A. Control of Excess Water		20			10	
B. Water Supply Augmentation and Conservation	10	30	5	20	20	
<b>II. WATER QUALITY PROBLEMS</b>						
A. Control of Entering Pollutants	15	30	10	25	40	
B. Effects of Pollution	10	30	10	15	30	
C. Water Treatment Processes and Disposal of Wastes	20	30	10	20	30	
<b>III. ENVIRONMENTAL IMPACT</b>						
A. Economic Effects	5	10		10	15	
B. Ecosystems Effects	10	20		10	20	
C. Public Welfare Effects	10	20	5	15	15	
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>						
A. Institutions	10	20		15	20	
B. Methods & Procedures	10	20	10	10	20	
C. Basic Data	10	20		10	10	
<b>TOTAL</b>	<b>110</b>	<b>250</b>	<b>50</b>	<b>150</b>	<b>230</b>	

## CLASSIFICATION LEGEND

C - Critical

S - Severe

\*Dollars in thousands (,000 omitted)



MONTANA'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

HELMER HOLJE, DIRECTOR  
MONTANA UNIVERSITY JOINT  
WATER RESOURCES RESEARCH CENTER



MONTANA-CRITICAL WATER PROBLEMS

PROBLEM AREA AND RESEARCH NEEDS DESCRIPTION	PROBLEM AREA (s) COORDINATE	RESEARCH CLASS- IFICATION
<p>1. <u>Supply Availability Problems</u></p> <p>One of the more critical water resources problem areas in Montana concerns water availability. With the increasing water demands for all sectors a very intense competitive situation is developing between and among water users and uses. For example, a long-term adjudication is underway on the Yellowstone. <u>Already the water demands exceed the water supplies several fold.</u> However, with proper research, planning and development there should be sufficient water for the foreseeable future.</p>	I B	I-BE III-BDE IV-E V-EHIJ VI-BCD
<p>2. <u>Water Quality Degradation</u></p> <p>The problem of a slow but ongoing degradation of water quality in almost every stream and river in Montana can only be solved by knowledge of the quantities and sources of pollutants from both point and non-point land use activities. In the state of Montana, as in most Missouri Basin states, logging, cattle grazing, mining and subdivisions are land use activities whose impacts upon water quality are not well defined. It is most important that research be undertaken to generate recommendations for practical safeguards and land-use methods for minimizing water quality degradation. It is likewise important to determine what the economic and <u>sociological costs</u> are when these safeguards are not established.</p>	II AB	II-BC III-DE
<p>3. <u>Regional Water Management</u></p> <p>Water resources are not constrained by political boundaries, and for many management problems it is necessary to recognize the regional nature of water resources research, planning and development. <u>With increasing use of water by all sectors of the economy,</u> it is vital that the approach to water resource use be on a regional and national basis. As an example, one needs only to look at the coal-energy development taking place in the Fort Union Formation of Montana, North Dakota and Wyoming. The problem of water development and use includes economic, legal, sociological and institutional constraints which require substantial research in order to find a satisfactory solution to the many and varied problems.</p>	III BC IV AB	II-A IV-BE VI-C III-DE





RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	I. HYDROLOGICAL		II. BIOLOGICAL		III. SOCIOLOGICAL		IV. PLANNING & MGT.		V. ENGINEERING		VI. DATA ACQUISIT.							
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
I. WATER QUANTITY	Atmospheric																	
	Water-Soil Interface																	
A. Control of Excess Water	Channel Flow																	
	Lakes, Estuaries																	
B. Water Supply Augmentation and Conservation	Groundwater																	
	Ice, Permafrost																	
II. WATER QUALITY	Watershed Ecosystems																	
	River Ecosystems																	
A. Control of Entering Pollutants																		
B. Effects of Pollution																		
C. Water Treatment Processes and Disposal of Wastes																		
III. ENVIRONMENTAL IMPACT																		
A. Economic Effects																		
B. Ecosystems Effects																		
C. Public Welfare Effects																		
IV. WATER PLANNING & MANAGEMENT																		
A. Institutions																		
B. Methods & Procedures																		
C. Basic Data																		

CLASSIFICATION LEGEND:  
 C - Critical  
 S - Severe



OFFICE OF  
WATER RESEARCH AND TECHNOLOGY  
WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: MONTANA

DATE: 10/10/75

REGION: MISSOURI

FISCAL YEAR 1978

PROBLEM AREAS	ALLOTMENT		MATCHING		TOTAL
	\$110	\$250	\$50	\$150	
<b>I. WATER QUANTITY PROBLEMS</b>					Unlimited
A. Control of Excess Water	10	20			75
B. Water Supply Augmentation and Conservation	50	100	40	50	
<b>II. WATER QUALITY PROBLEMS</b>					
A. Control of Entering Pollutants	10	30	-0-	30	30
B. Effects of Pollution	10	30	-0-	20	30
C. Water Treatment Processes and Disposal of Wastes	5	10			10
<b>III. ENVIRONMENTAL IMPACT</b>					
A. Economic Effects	10	20	-0-	20	30
B. Ecosystems Effects	5	15	-0-	20	40
C. Public Welfare Effects	-0-	5	-0-	-0-	10
<b>V. WATER PLANNING &amp; MANAGEMENT</b>					
A. Institutions	5	5			10
B. Methods & Procedures	5	10	10	10	28
C. Basic Data	-0-	5	-0-	-0-	10
<b>TOTAL</b>					265

CLASSIFICATION LEGEND  
C - Critical  
S - Severe



NEBRASKA'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

MILLARD W. HALL, DIRECTOR  
WATER RESOURCES RESEARCH INSTITUTE



NEBRASKA - CRITICAL WATER PROBLEMS

Problem Areas and Research Needs Description	Coordinates of Critical/ Severe Research Needs Associated with Problem
<u>Problem Area(s) Coordinate</u>	Research Classification Coordinate*
<p>I. <u>Effective Utilization of the Water Supply</u></p>	
<p>Much of Nebraska lacks sufficient precipitation to supply water for agriculture and other purposes. Because of the shortage of rainfall, irrigation is increasingly important as one progresses westward across the state. In addition to agricultural uses, growing urban needs and the demand for water based recreational opportunities compete for Nebraska's limited water supply.</p>	<p>I-B I-B(s) I-E(s) III-B(s) III-C III-E(s) V-B V-C V-E V-I V-J(s)</p>
<p>In some areas, the recent rapid expansion of irrigation has led to serious depletion of underground reservoirs with alarming declines in the level of groundwater. To ease the seasonal tax on the water supply and minimize evapotranspiration losses, the possibility of storage in some aquifers should be evaluated as well as the potential of recharge systems. Improved techniques for the recovery and reuse of excess water from irrigated areas are also needed.</p>	<p>----- II-A III-C III-E(s) V-B(s) V-C V-E(s) V-F(s)</p>
<p>In addition, most of the irrigation systems being introduced are pump systems which expand the problem of energy consumption. Additional research is needed to insure that water pumped for irrigation is used by the crop in an optimal fashion, i.e., no over irrigation or wasting of water through irrigation of the wrong crop, or at the wrong time.</p>	<p>----- III-C III-C(s)</p>
<p>Existing mechanism for allocating and regulating water supplies need to be examined and possible legislative remedies proposed and evaluated. In terms of allocation, interrelationship between ground and surface water must be examined and defined to develop a balanced program to satisfy conflicting water demands. Because of the critical nature of water availability in many areas of Nebraska, maximum efficiency must be achieved in the use of water by all sectors of society. This includes consideration of the minimum acceptable receiving water flow for transporting and diluting wastes as well as determining the minimal water requirements of industries.</p>	

\*Those marked (s) are severe and should be investigated within 3 to 5 years. Those not marked are critical and should be investigated within 1 to 2 years.





## II. Diffuse and Point Sources of Contaminants

Information on the magnitude and distribution of nonpoint pollution sources in Nebraska is virtually nonexistent. Data collection, monitoring, and analysis is needed to determine the sources, extent and location of such pollution so that rules and standards for water quality maintenance can be rationally established.

II-A

II-C  
II-D  
III-C(s)  
III-E  
VI-B  
V-G  
V-H

Nebraska's soils are highly susceptible to erosion, which leads to the need for understanding of the processes of sediment detachment and transport. The development of analytical models to predict the morphological behavior of eroding systems is a requirement for adequate long term control measures. Specific research on the effect of sediments on stream biota is also needed. The relationships between plant nutrients from diffuse runoff and the water quality of receiving lakes and streams must be defined more precisely. Much additional work is needed to evaluate the fate of herbicides, pesticides, and fungicides in the environment resulting from the movement of these materials through the soils and water and the possible harmful effects on wildlife and human populations as a result of recycling this water.

II-B

II-C  
II-D

II-C

III-C(s)  
III-E(s)  
V-B  
V-G  
V-H

III-C

III-C

Although more thoroughly studied than diffuse pollution, most of the efforts for control of point source pollution have been in the areas of treatment, collection and disposal of urban, domestic and industrial wastewaters. Quantification of the magnitude and type of pollution as well as further understanding of the effects of such pollution is needed in addition to practical methods for control of these contaminants. The biological effects of a large number of pollutants are unknown as are economic treatment systems for enormous volumes of water. Research is also needed on the necessary quality of waters for a variety of recycle and reuse systems.

## III. Lake and Reservoir Quality Degradation

Lakeshore development, sedimentation and runoff from agricultural lands, feedlots and urban areas are placing increasing stress on the quality of both manmade and natural lakes in Nebraska. Little is known regarding the bio-physical-chemical interactions that occur in lakes and reservoirs although there has been extensive research. Much basic research is needed for the development of quantitative models of these interactive systems.

II-A

II-C  
IV-B(s)

II-B

II-C  
II-D  
III-C  
IV-B



Safe and economical methods for controlling eutrophication of lakes and reservoirs and the manifestations of this phenomenon are still needed although there have been years of research in these areas. The biological control of this type of pollution is needed as well as analytical models for classifying lakes and reservoirs in accordance with their trophic status and for predicting shifts in this status resulting from man-induced stresses. Also, there is a definite need for interpretation and dissemination of research results in this area.

V-G  
V-H

#### IV. Planning Methodologies

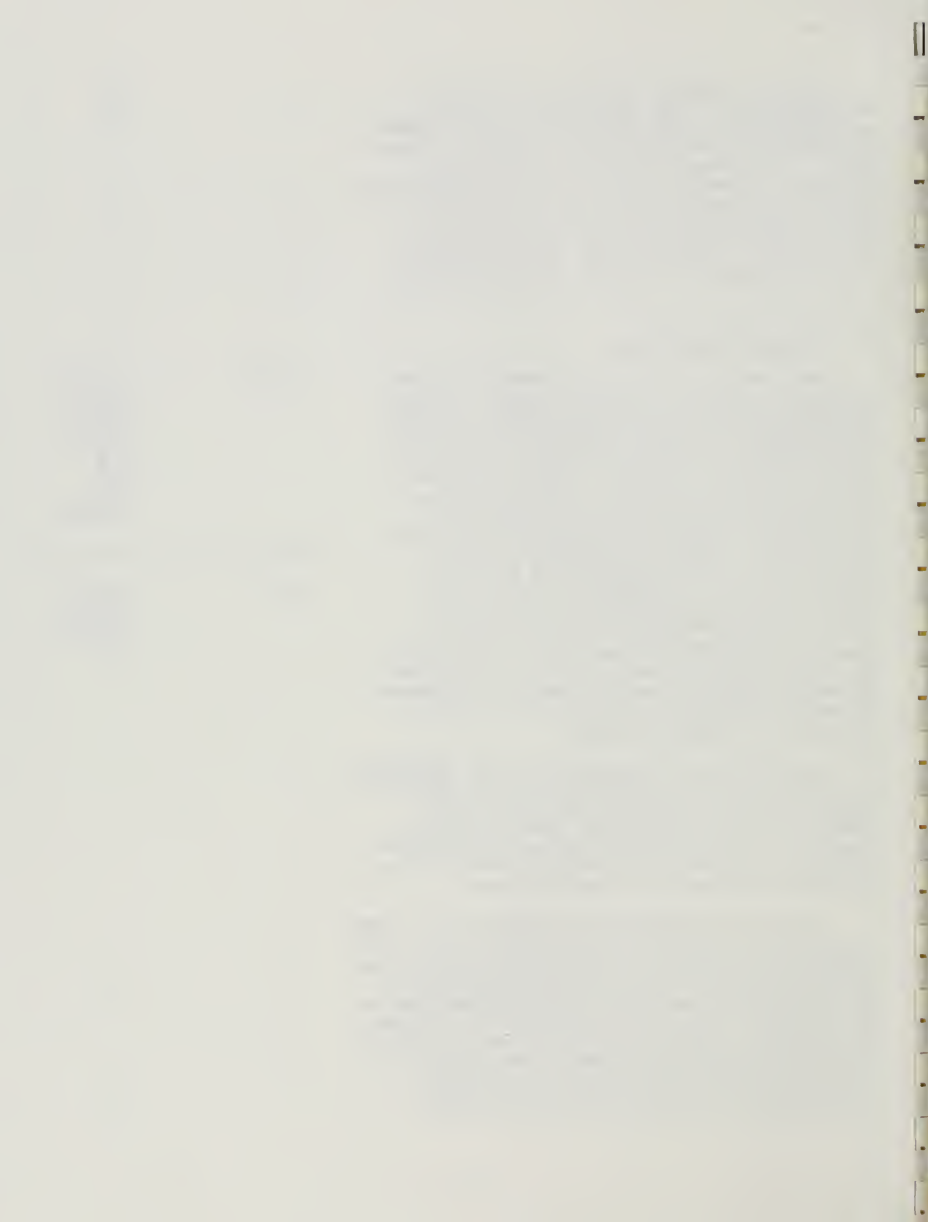
The limited water supply in Nebraska and the increasing demand on it require the most efficient management and planning systems possible. Planning and management processes associated with land and water development encompass economic, technical, social, political, and legal aspects which need to be researched individually. The complex systems which incorporate these aspects must also be investigated. Though much has been learned about the processes involved in planning, there is a great need to provide methodologies which treat planning regions as comprehensive systems reflecting interaction between physical, environmental, and human factors. Areas which need improved management techniques must be evaluated in terms of existing legal, political, social, and economic constraints, and the impacts of slackening or removing these constraints must be studied as a mechanism for suggesting change.

IV-B  
III-B(s)  
III-C  
III-D(s)  
III-E(s)  
IV-B  
IV-C  
IV-D(s)  
IV-E(s)

-----  
IV-C  
VI-A(s)  
VI-B(s)  
VI-C(s)  
VI-E

Techniques for the identification and measurement of objectives must be improved and further emphasis must be placed on developing interrelationships between objectives. Additional research is also required for identifying the various trade-offs in different alternatives and for establishing pricing practices consistent with plan utilization.

Planning and management also depend on data from which analyses can be made and theories tested. The traditional approaches to data gathering need review, and conventional data networks need modernizing. Research directed toward the design of comprehensive environmental data-collection and monitoring systems is important. Another necessity to receive the full benefits from developments made is the complete documentation and instruction for the effective utilization for the models which are developed.



RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

	I. HYDROLOGICAL			II. BIOLOGICAL			III. SOCIOLOGICAL			IV. PLANNING & MGT.			V. ENGINEERING			VI. DATA ACQUISIT.		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Atmospheric																		
Water-Soil Interface																		
Channel Flow																		
Lakes, Estuaries																		
Groundwater																		
Ice, Permafrost																		
Watershed Ecosystems																		
River Ecosystems																		
Lakes, Estuaries																		
Bio-Chemical																		
Political Action																		
Public Information																		
Goal Indicators																		
Economic																		
Legal																		
P&M Organizations																		
Problem Identification																		
Action, Design																		
Plan Evaluation																		
Decision-Making																		
Operations																		
Construction																		
Water Treatment																		
Wells, Recharge Sys.																		
Flood Protection																		
Water Supply																		
Navigation																		
Eutrophication Control																		
Frostion, Sed. Control																		
Irrigation																		
Watershed Improvement																		
Hydrologic Data																		
Biologic Data																		
Sociologic Data																		
Engineering Data																		
Information Storage																		
Transfer Systems																		

SYSTEMS & PROCESSES (RESEARCH)	I. HYDROLOGICAL			II. BIOLOGICAL			III. SOCIOLOGICAL			IV. PLANNING & MGT.			V. ENGINEERING			VI. DATA ACQUISIT.		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<u>PROBLEM AREAS</u>																		
<u>I. WATER QUANTITY</u>																		
A. Control of Excess Water																		
B. Water Supply Augmentation and Conservation																		
<u>II. WATER QUALITY</u>																		
A. Control of Entering Pollutants																		
B. Effects of Pollution																		
C. Water Treatment Processes and Disposal of Wastes																		
<u>III. ENVIRONMENTAL IMPACT</u>																		
A. Economic Effects																		
B. Ecosystems Effects																		
C. Public Welfare Effects																		
<u>IV. WATER PLANNING &amp; MANAGEMENT</u>																		
A. Institutions																		
B. Methods & Procedures																		
C. Basic Data																		

46  
 CLASSIFICATION LEGEND:  
 C - Critical  
 S - Severe



OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: NEBRASKA

DATE: 10/15/75

REGION: Missouri Basin

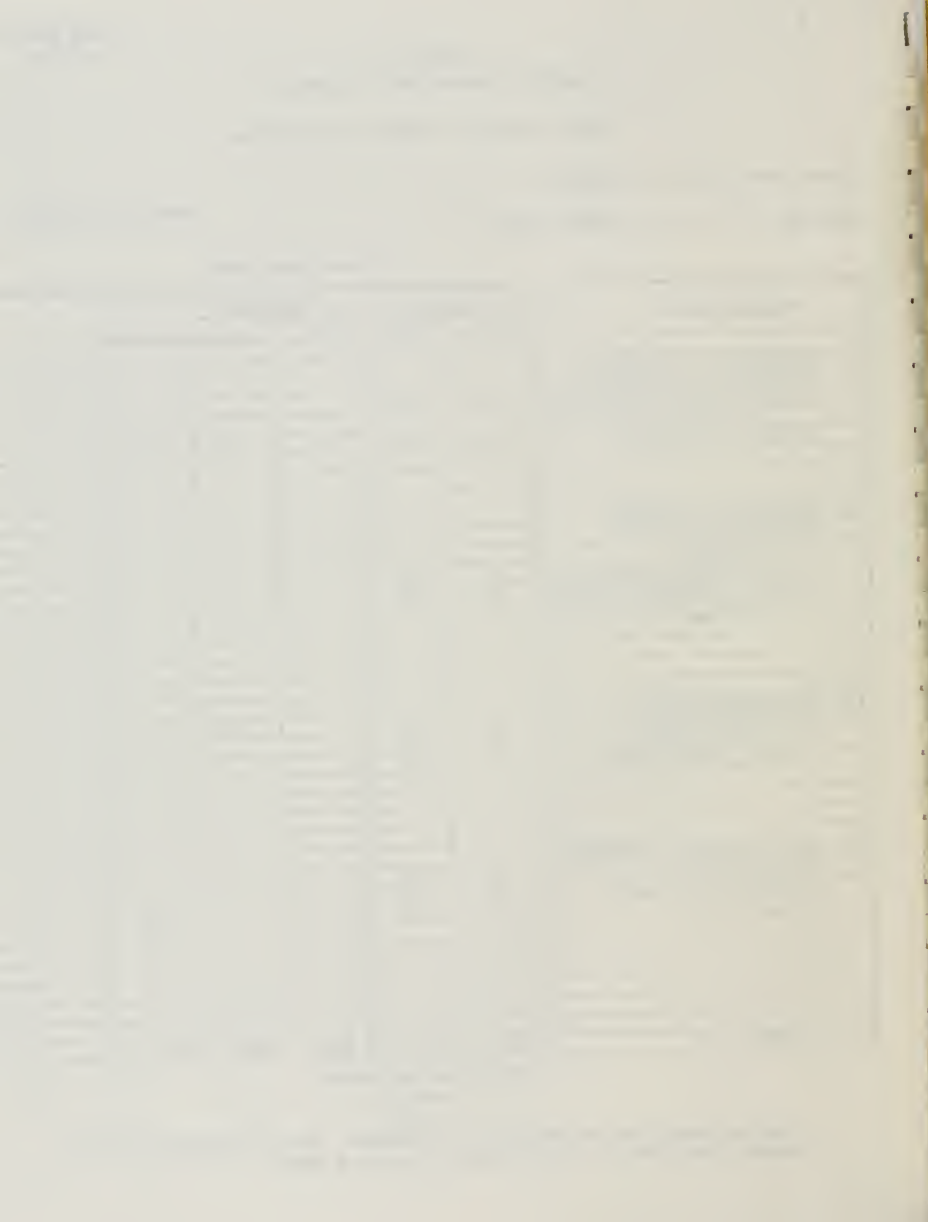
FISCAL YEAR 1978

PROBLEM AREAS	Allotment		Matching*		
	\$110	\$250	\$50	\$150	unlimited
<b>I. WATER QUANTITY PROBLEMS</b>					
A. Control of Excess Water					
B. Water Supply Augmentation and Conservation	10	20			
C. Water Utilization	30	80	50	115	242
<b>II. WATER QUALITY PROBLEMS</b>					
A. Control of Entering Pollutants					
B. Effects of Pollution	15	35			
C. Water Treatment Processes and Disposal of Wastes	10	30			
<b>III. ENVIRONMENTAL IMPACT</b>					
A. Economic Effects	5	10		20	
B. Ecosystems Effects	10	15			
C. Public Welfare Effects	5	10			
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>					
A. Institutions	5	10			
B. Methods & Procedures	15	30		15	75
C. Basic Data	5	10			53
<b>TOTAL</b>	<b>\$110</b>	<b>\$250</b>	<b>\$50</b>	<b>\$150</b>	<b>\$370</b>

CLASSIFICATION LEGEND

- C - Critical
- S - Severe

\* These ceilings do not reflect reality in Nebraska. We will undoubtedly submit proposals requiring more than \$300,000 in matching funds.





NORTH DAKOTA'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

ROBERT KOOB, DIRECTOR  
WATER RESOURCES RESEARCH INSTITUTE



NORTH DAKOTA CRITICAL WATER PROBLEMS

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Areas</u>	<u>Systems and Processes</u>
<p>1. <u>Energy Development.</u> The impact on quantity and quality of water caused by the introduction of major new water consuming industry in the state is now of critical concern both regionally and nationally. The aspects of this problem appear innumerable. Who decides who gets how much water? How? What pre and post treatments are necessary, if any, for water used by a gasification plant? An electric utility? A fertilizer manufacturer? etc... How are effluents to be handled? Will evaporation affect weather? Will stream discharge harm rivers? Will holding ponds affect groundwater? Immediate action, in the form of site specific studies using newly constructed plants, is required. From specific examples generalization to usable guidelines for future activities may be generated.</p>	<p>II B II C III A III B IV B</p>	<p>I B,E; II A-D; VI B V B III D II A-D II B</p>
<p>2. <u>Water Management in Closed Basins.</u> In a "closed" (no effluent streams) basin, the impact of one kind of water management action on other parameters becomes more apparent than usual. In one area in North Dakota (Devils Lake Basin) conflicts have grown to crisis proportions. In the arena: farm owners and operators faced with sheet flooding in four of the last seven years and government owned and leased wetlands; U.S. Fish and Wildlife Service trying to pressure an important natural resource (prairie pothole wetlands); and the city of Devils Lake which could lose as much as one-half of the incorporated community to a rising Devils Lake. The most beneficial compromise to all citizens must be reached but causes of the problem and effects of recommended action must be determined. A basin wide study including hydrological parameters, environmental units, sociological parameters, economics and law have begun. It is critical that this program is continued and expanded.</p>	<p>I A III A III B III C</p>	<p>III A,B I D; II A I D; II A I D; II A</p>
<p>3. <u>Irrigation.</u> The impact of the Garrison Diversion on water quality on different river basin systems, one of which drains into Canada, has been seriously questioned by those with environmental concerns. Irrigation practices, leaching effects and return flow volumes and quality must be determined for model projects.</p>	<p>I B II A II B III B</p>	<p>II A,B I B-E II A, B I C, II B</p>



RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES  
(RESEARCH)

PROBLEM AREAS

WATER QUANTITY  
A. Control of Excess Water  
B. Water Supply Augmentation  
and Conservation

I. WATER QUALITY  
A. Control of Entering  
Pollutants  
B. Effects of Pollution  
C. Water Treatment Processes  
and Disposal of Wastes

II. ENVIRONMENTAL IMPACT  
A. Economic Effects  
B. Ecosystems Effects  
C. Public Welfare Effects

IV. WATER PLANNING & MANAGEMENT  
A. Institutions  
B. Methods & Procedures  
C. Basic Data

I. HYDROLOGICAL	II. BIOLOGICAL				III. SOCIOLOGICAL				IV. PLANNING & MGT.				V. ENGINEERING				VI. DATA ACQUISITION			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Atmospheric																				
Water-Soil Interface																				
Channel Flow																				
Lakes, Estuaries																				
Groundwater																				
Ice, Permafrost																				
Watershed Ecosystems																				
River Ecosystems																				
Lakes, Estuaries																				
Bio-Chemical																				
Political Action																				
Public Information																				
Goal Indicators																				
Economic																				
Legal																				
R&M Organizations																				
Problem Identification																				
Action, Design																				
Plan Evaluation																				
Decision-Making																				
Operations																				
Construction																				
Water Treatment																				
Wells, Recharge Sys.																				
Flood Protection																				
Water Supply																				
Navigation																				
Eutrophication Control																				
Frost, Sed. Control																				
Irrigation																				
Watershed Improvement																				
Hydrologic Data																				
Biologic Data																				
Sociologic Data																				
Engineering Data																				
Information Storage																				
Transfer Systems																				

50 CLASSIFICATION LEGEND:  
C - Critical

N. DAKOTA



OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: North Dakota

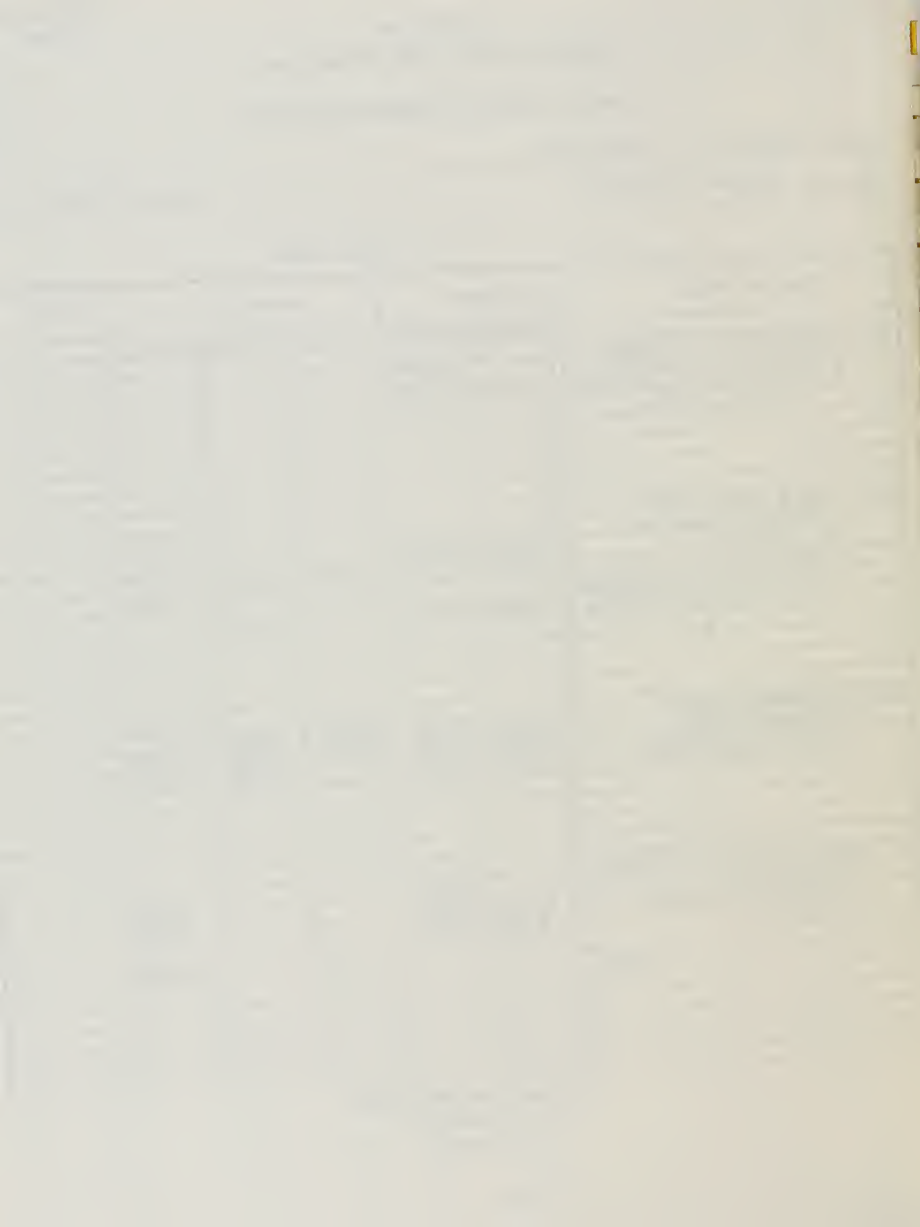
REGION: Missouri River Basin

DATE: 10-15-75

FISCAL YEAR

PROBLEM AREAS	Allotment		Matching			TOTAL
	110,000	250,000	50	150,000	unlimited	
<b>I. WATER QUANTITY PROBLEMS</b>						
A. Control of Excess Water		20,000				
B. Water Supply Augmentation and Conservation	10,000	20,000				
<b>II. WATER QUALITY PROBLEMS</b>						
A. Control of Entering Pollutants	10,000	30,000				25,000
B. Effects of Pollution	30,000	40,000	10,000	25,000		75,000
C. Water Treatment Processes and Disposal of Wastes	10,000	20,000		25,000		25,000
<b>III. ENVIRONMENTAL IMPACT</b>						
A. Economic Effects	10,000	20,000	20,000	20,000		75,000
B. Ecosystems Effects	15,000	50,000	20,000	50,000		100,000
C. Public Welfare Effects	10,000	20,000		30,000		75,000
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>						
A. Institutions		10,000				
B. Methods & Procedures	10,000	10,000				15,000
C. Basic Data	5,000	10,000				10,000
<b>TOTAL</b>						400,000

CLASSIFICATION LEGEND  
C - Critical  
S - Severe





SOUTH DAKOTA'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

JOHN L. WIERSMA, DIRECTOR  
SOUTH DAKOTA WATER RESOURCES INSTITUTE

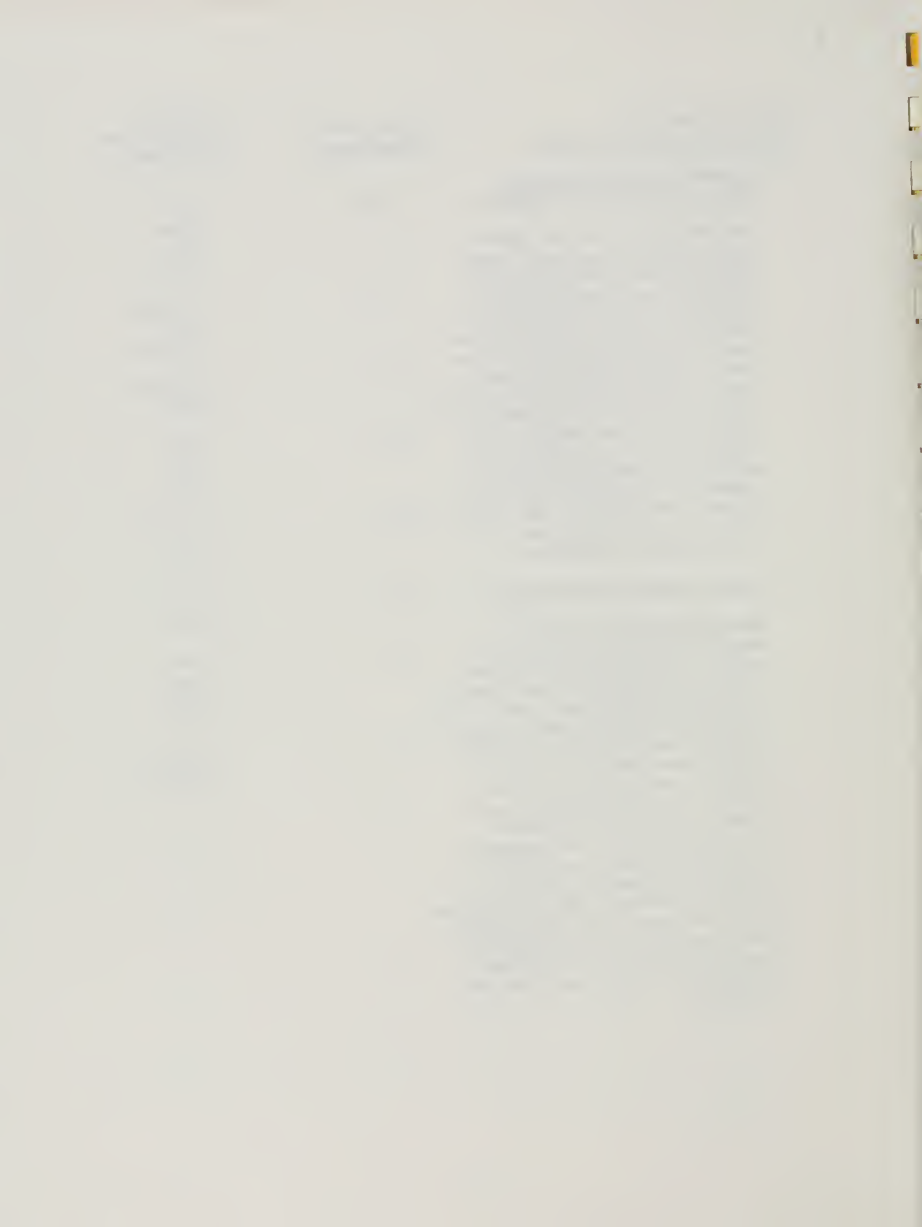


CRITICAL PROBLEMS OF THE STATE OF SOUTH DAKOTA

<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>	
1. <u>Utilization of surface and Subsurface Waters</u>  Research needs include investigations on the integration of surface and groundwaters. There is a need for model development to modernize the economic use of each source with regard to type of utilization and point of use. The use of pipe lines for transport for interbasin transfers for intensive use such as rural water needs and/or marketing for industrial use needs investigation.	I-B	I-E	
	IV-A	III-A(s) III-D III-E(s)	
	IV-B	III-C IV-D IV-E	
	IV-C	VI-C(s)	
2. <u>Improving Water Use Efficiency</u>  Research needs to be directed primarily towards the agricultural sector but includes domestic, industrial and energy generation uses. There is a need for techniques for the estimation of amount of water needed for irrigation based on soil, timing, antecedent moisture, root depths, and crop water requirement as it varies with management practices.	I-B	I-B(s) I-E V-C V-I	
	II-A	I-D I-E(s) II-D IV-B V-C V-G V-J(s)	
		II-B	II-A II-B(s) II-C
		II-C	V-B(s) V-E(s)
3. <u>Man's Impact on Water Quality</u>  An area of immediate concern is the relationship of point and non-point pollution to the total problem. This affects decisions to be made relative to control of the eutrophication of prairie lakes, management of reservoirs as related to sedimentation and types of land use management systems to be adapted. A unique problem exists where conservation practices are contributing to the formation of seep areas which causes the lands to be non-productive.	II-A	I-D I-E(s) II-D IV-B V-C V-G V-J(s)	
	II-B	II-A II-B(s) II-C	
	II-C	V-B(s) V-E(s)	



<u>Problem Areas and Research Needs Descriptions</u>	<u>Problem Area(s) Coordinate</u>	<u>Research Classification Coordinate</u>
4. <u>Economic and Environmental Effects of Water Development</u>	I-A	I-B II-B V-A V-H
The development of the James River Valley using water from the Oahe reservoir will modify existing conditions which may cause severe and nearly irreversible changes to the physical and biological integrity of the area. Research needs to identify the modifications which will result, assess the environmental impact on various segments of the population, determine economic effect and devise means to compensate those adversely affected. The quantity and quality of irrigation return flows is of particular importance.	I-B III-A III-B III-C	I-B(s) I-C I-E(s) III-C(s) III-D II-A II-B II-C III-C(s) III-E
5. <u>Water Planning and Management</u>	IV-A	III-A(s) III-E
Research needs to be able to resolve the multi-dimensional conflicts over water allocation. This will require the development of rational, consistent, and acceptable institutional arrangements between local, state and federal governments, as well as policies and criteria for the making of environmentally sound economic decisions. Although there appears to be an abundance of water available, needs for irrigation expansion, electric power, recreation, and the emerging new water needs for coal development have precipitated conflicts about allocations. The status of Indian water rights must also be resolved.	IV-B IV-C	III-D IV-A(s) IV-D IV-E VI-A(s) VI-C(s)









OFFICE OF  
WATER RESEARCH AND TECHNOLOGY

## WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: South DakotaDATE: 10-13-75REGION: Missouri Basin

FISCAL YEAR 1978

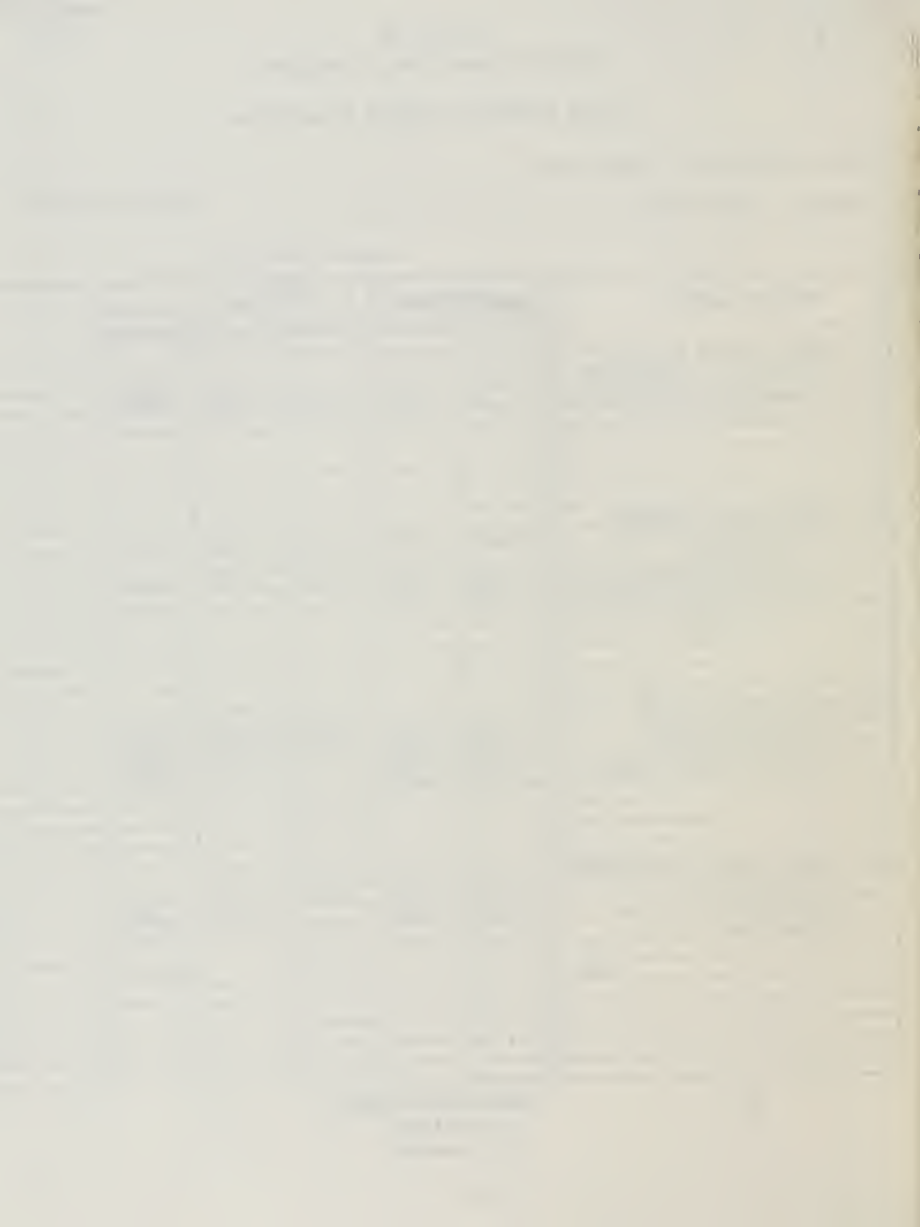
PROBLEM AREAS	Allotment		Matching		
	\$110,000	\$250,000	\$ 50,000	\$150,000	Unlimited
<b>I. WATER QUANTITY PROBLEMS</b>					
A. Control of Excess Water	15,000	40,000		10,000	50,000
B. Water Supply Augmentation and Conservation	15,000	30,000	15,000	25,000	30,000
<b>II. WATER QUALITY PROBLEMS</b>					
A. Control of Entering Pollutants	20,000	30,000	5,000	15,000	30,000
B. Effects of Pollution	10,000	20,000	10,000	20,000	20,000
C. Water Treatment Processes and Disposal of Wastes	5,000	10,000			10,000
<b>III. ENVIRONMENTAL IMPACT</b>					
A. Economic Effects	5,000	20,000	10,000	20,000	50,000
B. Ecosystems Effects	10,000	30,000		20,000	40,000
C. Public Welfare Effects	5,000	10,000			10,000
<b>IV. WATER PLANNING &amp; MANAGEMENT</b>					
A. Institutions	10,000	30,000	10,000	20,000	30,000
B. Methods & Procedures	15,000	30,000		20,000	20,000
C. Basic Data					10,000
<b>TOTAL</b>					300,000

0  
0

## CLASSIFICATION LEGEND

C - Critical

S - Severe



WYOMING'S  
WATER RESOURCES PROBLEMS  
AND  
STUDY NEEDS

PAUL A. RECHARD, DIRECTOR  
WATER RESOURCES RESEARCH INSTITUTE



## WYOMING - CRITICAL WATER PROBLEMS

### I. Water Quality

#### Problem

A critical problem in Wyoming for water resources research relates to the availability of water and the competition for the supply. Wyoming has a severe spacial distribution problem as regards water supply and water requirements. Some portions of the State have more surface water supply than can be consumed locally while other areas, including those of intense interest for potential coal development, have a scarcity problem. Since most of the water in Wyoming derives from snowmelt, there is temporal maldistribution of water supply as well. Compacts, treaties and court decrees also affect the ability to manipulate the available water supply for stated water demands.

Wyoming included water allocation and instream flow needs with the water quantity problem area. Probably these problems are the most pressing ones for Wyoming today. Instream flows can have a critical impact on the water supply available for development and also will affect decisions concerning water allocation problems.

Problems: I B, C, D.

#### Research Need

With the potential influx of industry to Wyoming, there is a need to provide the water supply necessary for industry without injuring the current agricultural economy. Industry, in many instances, is working with agriculture to develop new storage and diversion facilities and is interested in cooperative endeavors. The economics of the situation and legalities involved often control the scope of the development.



Ground water is a virtual unknown factor in much of Wyoming. Much research is necessary to define the existence and availability of ground water as a potential source of supply to industries, municipalities and agriculture.

Understanding the snowmelt process and watershed management potentials is of utmost importance in augmenting the water supplies in Wyoming. Improved watershed models, precipitation measurements and network designs are needed.

The instream flow requirements for stream and riparian ecosystems need to be defined and the criteria for determining these requirements must be established. Too often rules-of-thumb are used to estimate needs with serious impacts on water development.

Methodology for enhancing ecosystems by channel modification needs to be developed. Many times due to legal or physical constraints it is not possible to maintain a desired flow level so the best use of obtainable flows should be made. Criteria for modifying channels is sorely needed.

Processes: I B, C, E, G; II A, B; III A, B, C, D, E; IV D; V C, E, I, J; VI E.





## II. Water Quality

### Problem

At the present time Wyoming finds itself in the enviable position of having comparatively little quality-degraded water. However, this fact does not diminish the extent of the problem, because the maintenance of high quality water is of critical importance. With the increasing industrial development and concomitant increase in municipal supply and waste treatment, a water quality research problem exists. This is especially true with the potential pollution from mineral extraction industries.

There are some smaller communities in Wyoming which are using water of inferior quality and it would be beneficial to upgrade their supply.

With the impetus of PL 92-500, there are several communities in Wyoming considering waste treatment by irrigating with sewage effluent or total containment for evaporation. Such activities could have critical impacts on Wyoming water law, streamflow regimen, and potential uses.

Potential releases of inorganic and organic pollutants from coal mines, coal conversion plants and oil shale extraction plants may pose increasingly serious problems for Wyoming in the future. The potential accumulation of these same compounds in ground water near in situ coal conversion operations may pose a serious problem for agricultural and municipal ground water users.

Problems: II A, B, C.

### Research Needs

Information on cycling, bioaccumulation and environmental effects of some potential pollutants is completely lacking, especially the organics from proposed coal conversion plants. This potential problem is particularly



serious since some of these organics are suspected or proven carcinogens or teratogens. Research must be initiated now so that water quality criteria can be established and waste treatment systems can be assigned for these compounds prior to full development of the coal conversion industry in Wyoming.

As in situ conversion experiments are initiated in this State, chemical monitoring studies on near-by ground water should be funded in order to determine the potential degree of seriousness of this problem.

The impacts of "no discharge of pollutants" on the State needs to be determined. This will require research on return flows, channel loss and gain characteristics and flow rating.

There are many instances of saline water entering streams in Wyoming due to natural causes. The increase in salt load is not always due to the influence of man; however, the source of pollution must be determined and corrective measures, if possible, defined.

Processes: I B, E; II A, B, D; III D; IV D; V C, I; VI A, B.



### III. Environmental Impact

#### Problem

The environment of Wyoming is highly prized by resident and non-resident alike. The potential impacts of resource development, especially coal, oil shale and uranium, on the environment are of concern to everyone. A major effort is now underway to define environmental impacts of any large-scale development prior to development.

Recreational development is often made a secondary item in project development with resulting decrease in the recreational potential.

Problems: III A, B, C.

#### Research Needs

Specific cause and effect interactions of hydrologic and biologic phenomena need to be identified and quantified. Watershed or ecosystem models must be developed to help interpret the existing or baseline conditions and to help predict impacts of development. Methods for monitoring the environment, such as network of ground water observation wells, need to be defined. Impacts of man's alteration of stream channels for a specific purpose on the environment need to be defined. Criteria for modifying channels need to be developed.

The economic effects of environmental impacts must be quantified in some manner, because the decision makers need such tools to properly evaluate the pros and cons of development or non-development.

The public's interpretation and desires for environmental concerns need to be determined. Sociologic and political science approaches must be undertaken to more actively involve the entire "Public."



Techniques for realigning project development objectives with changing conditions need to be developed.

Processes: I A, B, C, E; II A, B; III B, C, D, E; IV D; V C, E, I;  
VI A, B, C, E.





#### IV. Water Planning and Management

##### Problem

Demands for water for irrigation and coal development require efficient and effective planning and management. With increased use of and demand for water supply, it is vital that the institutions influencing the development and utilization of water provide a coordinated regional framework within which Federal, State and local governments and private industry can operate.

There have grown up conflicting sets of laws, rules and regulations within the same governmental layer and between different governmental layers. A typical example would be the municipality which is required under one Federal law to cease discharging water back to a stream yet in so doing violates State water rights laws.

Problems: IV, A, B, C,

##### Research Needs

Research into ways of simplifying procedures, consolidating permit requirements into fewer agencies with a consolidation of hearings, reports, and related actions and general institutional streamlining needs to be accomplished.

In some instances, rules and regulations are developed for a particular situation in one area but they are completely unnecessary in another region or area. Some methods and procedures should be developed to provide proper indices for different situations.

Processes: I E; II A, B; III D, E; IV B, D; V J; VI A, B, C, E.



RESEARCH WILL DEAL WITH THESE SYSTEMS & PROCESSES

SYSTEMS & PROCESSES (RESEARCH)	I. HYDROLOGICAL			II. BIOLOGICAL			III. SOCIOLOGICAL			IV. PLANNING & MGT.			V. ENGINEERING			VI. DATA ACQUISITION												
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J	
PROBLEM AREAS	Atmospheric	Water-Soil Interface	Channel Flow	Lakes, Estuaries	Groundwater	Ice, Permafrost	Snow	Watershed Ecosystems	River Ecosystems	Lakes, Estuaries	Bio-Chemical																	
	A	B	C	D	E	F	G	A	B	C	D																	
WATER QUANTITY																												
A. Control of Excess Water																												
B. Water Supply Augmentation and Conservation																												
C. Water Allocation																												
D. Estuary Flows																												
WATER QUALITY																												
A. Control of Entering Pollutants																												
B. Effects of Pollution																												
C. Water Treatment Processes and Disposal of Wastes																												
ENVIRONMENTAL IMPACT																												
A. Economic Effects																												
B. Ecosystems Effects																												
C. Public Welfare Effects																												
WATER PLANNING & MANAGEMENT																												
A. Institutions																												
B. Methods & Procedures																												
C. Basic Data																												

CLASSIFICATION LEGEND:



## WATER RESEARCH AND TECHNOLOGY

## WATER RESOURCE PROBLEM PROJECTION

STATE INSTITUTE: WYOMINGDATE: Oct. 1975REGION: Missouri, Colorado, Great Basin and Snake

FISCAL YEAR 1978

PROBLEM AREAS	allotment		Matching			TOTAL
	110,000	250,000	50,000	150,000	unlimited	
I. WATER QUANTITY PROBLEMS						
A. Control of Excess Water				10,000	10,000	
B. Water Supply Augmentation and Conservation	20,000	40,000	10,000	20,000	50,000	
C. Water Allocation	20,000	30,000		20,000	50,000	
D. Instream Flow	10,000	20,000	10,000	20,000	30,000	
II. WATER QUALITY PROBLEMS						
A. Control of Entering Pollutants	10,000	10,000		10,000	10,000	
B. Effects of Pollution	10,000	20,000		10,000	20,000	
C. Water Treatment Processes and Disposal of Wastes		10,000		10,000		
III. ENVIRONMENTAL IMPACT						
A. Economic Effects	10,000	25,000	10,000	10,000	20,000	
B. Ecosystems Effects	10,000	20,000	10,000	20,000	50,000	
C. Public Welfare Effects		10,000			10,000	
IV. WATER PLANNING & MANAGEMENT						
A. Institutions	10,000	15,000			20,000	
B. Methods & Procedures	20,000	40,000	10,000	10,000	10,000	
C. Basic Data		10,000		10,000	50,000	

## CLASSIFICATION LEGEND

C - Critical- of immediate concern

S - Severe- but less than critical





